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THE WORLD

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Western Hemisphere



Eastern Hemisphere



Northern Hemisphere



Southern Hemisphere



Western Hemisphere



Eastern Hemisphere



Northern Hemisphere



Southern Hemisphere

THE WORLD

The Complete Geography Series

THE WORLD

BY

ALYS MAMOUR

AUTHOR OF: THE COMPLETE ENGLISH SERIES, ETC.

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NOTE

The four volumes in this series have been designed to provide a complete course in Geography for pupils aged over 11. The volumes are self-contained and may also be used independently. The general scheme of the series is in exact accordance with suggestions advanced in official publications on geography teaching.

The keynote of *The Complete Geography Series* may be summed up in the words Reliability and Readability, but attention might be drawn to the introduction of some noteworthy features, such as the exercises at the end of each chapter and the many short excerpts from travel books. The exercises have been so planned as to form a résumé of the subject studied, and also give scope, in the "Local Study", for practical work relevant to the current assignment in Geography. The extracts quoted from travellers' accounts and authoritative books have been arranged as part of the text ; their first-hand vividness serves to sustain interest, enabling pupils easily to follow and enjoy the facts presented, and since they are the only descriptive passages, readers can readily distinguish between facts and description when making notes.

Other attractive points in the series are the maps specially prepared for the chapters showing the important places mentioned ; the numerous illustrations supplied by governments and other reliable sources ; the suggestions on geography games and handwork ; and especially the treatment of the various countries in such a way that none is dealt with either in very great detail or too briefly, in order that a balanced knowledge of them may be obtained.

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ON GEOGRAPHY

“ School geography must be the geography of geographers, not the mere learning of geographical data and results.”

—*British Association*

“ Whatever method is adopted, descriptive teaching should predominate.”

—*London County Council*

“ First-hand vivid narrations will naturally play a great part.”

—*Board of Education*

“ It is to me a standing marvel how scholars can endure to have only the names of hills and rivers on their lips, and never one line of conception of them in their mind's sight.”

—JOHN RUSKIN

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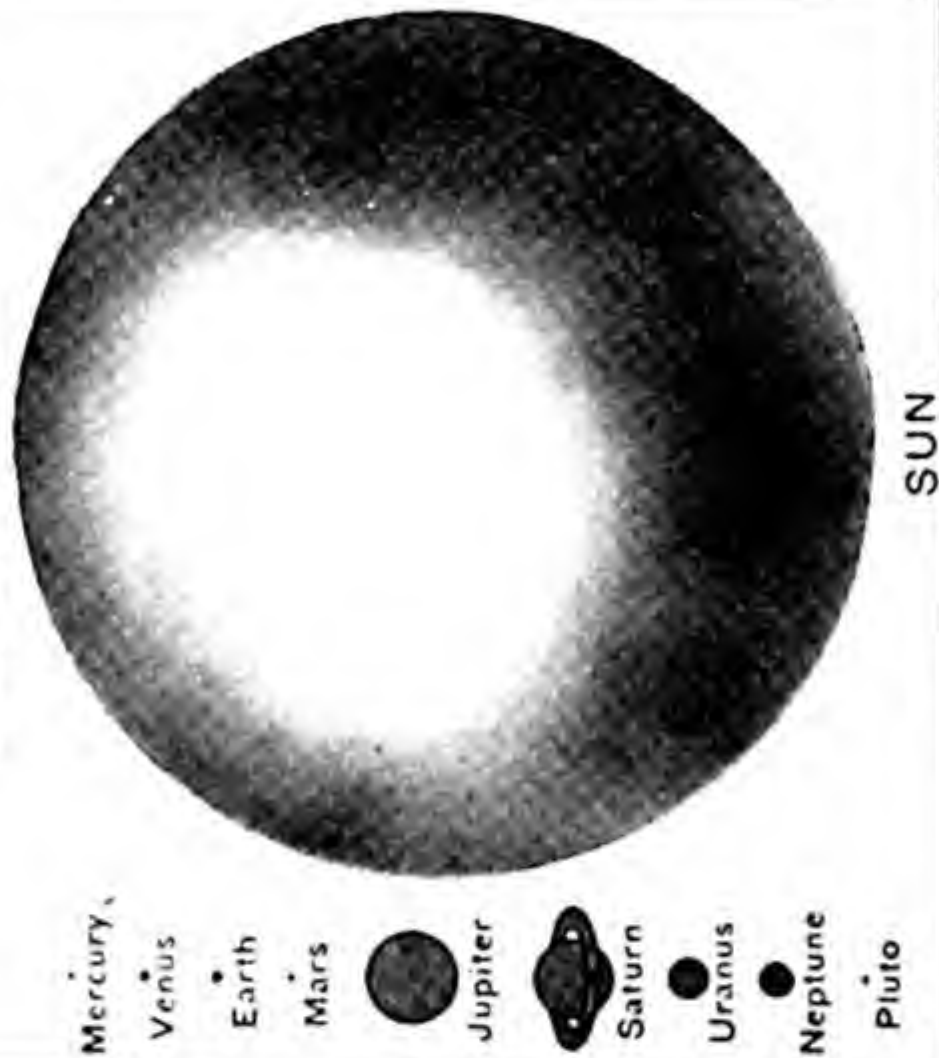
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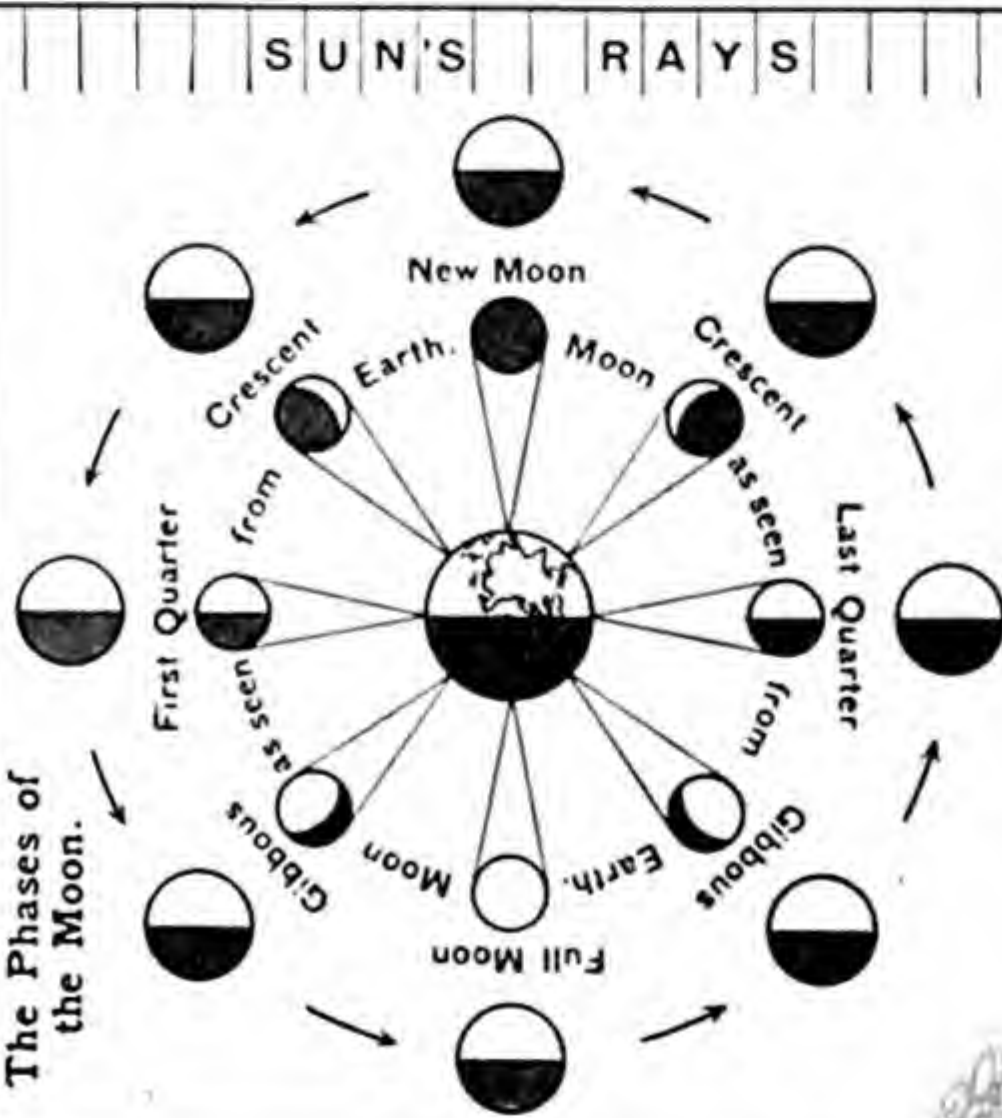
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CHAPTER ONE

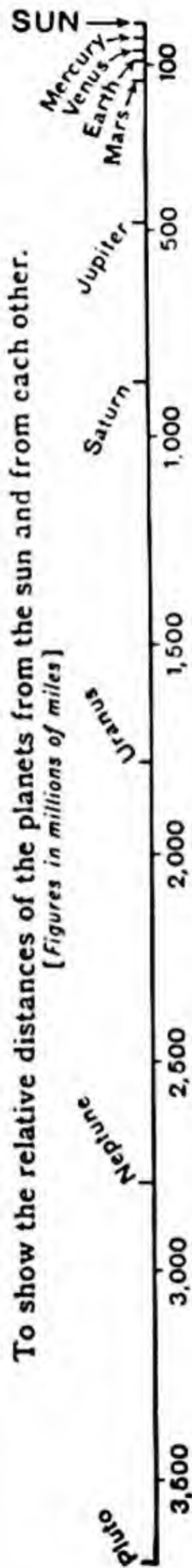
To show the relative sizes of members of the Solar System.



The Phases of the Moon.



To show the relative distances of the planets from the sun and from each other.
[Figures in millions of miles]



CHAPTER ONE

THE UNIVERSE

THE SOLAR SYSTEM

The earth on which we live is one of nine planets which, together with hundreds of asteroids, occasional comets, and small and large masses of meteoric matter, circle round the star we call the sun, forming the group known as the solar system.

THE SUN, our source of heat and light, is a huge sphere of white-hot gaseous matter more than a million times the size of the earth.¹ It does not appear large to us because it is 93 million miles away. An aeroplane from the earth flying continuously at 300 miles an hour would take more than 35 years to reach it.

The sun is made up of the same elements as the earth (oxygen, hydrogen, iron, copper, platinum, etc.), but with this difference that they are present in the sun in gaseous and liquid form hurtling about at very high temperatures, and sending out immense amounts of energy, which reach the members of the solar system as light, heat and electric rays.

“Either of the two methods of determining stellar temperatures indicates that the temperature of the sun’s surface is about 6,000 degrees absolute, which is 2,000 degrees hotter than the hottest part of the electric arc.”

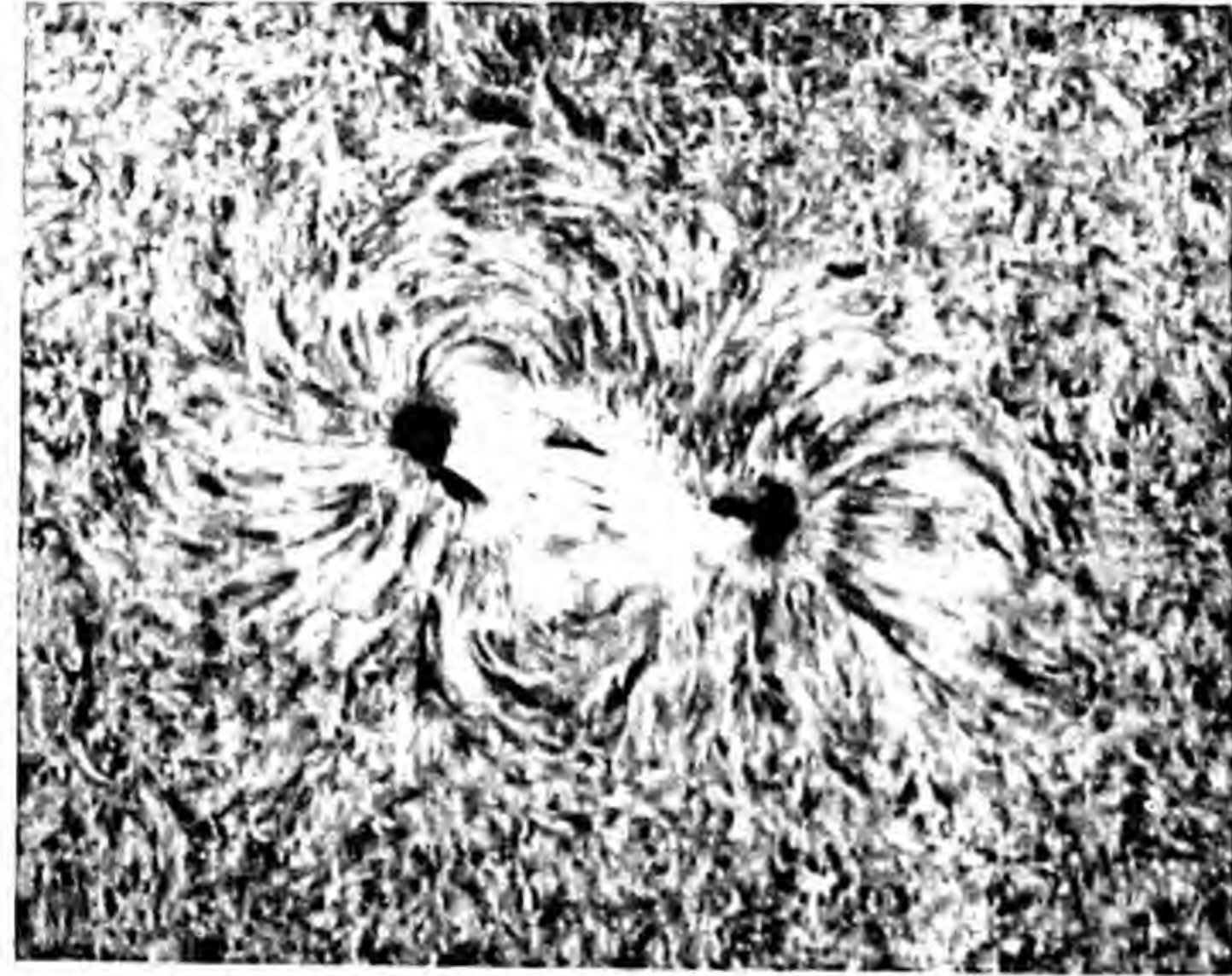
SIR JAMES JEANS

Frequently the sun is swept by storms and electrical explosions. These are believed to centre round those areas on its surface which can be seen as small dark splashes and are called sunspots.

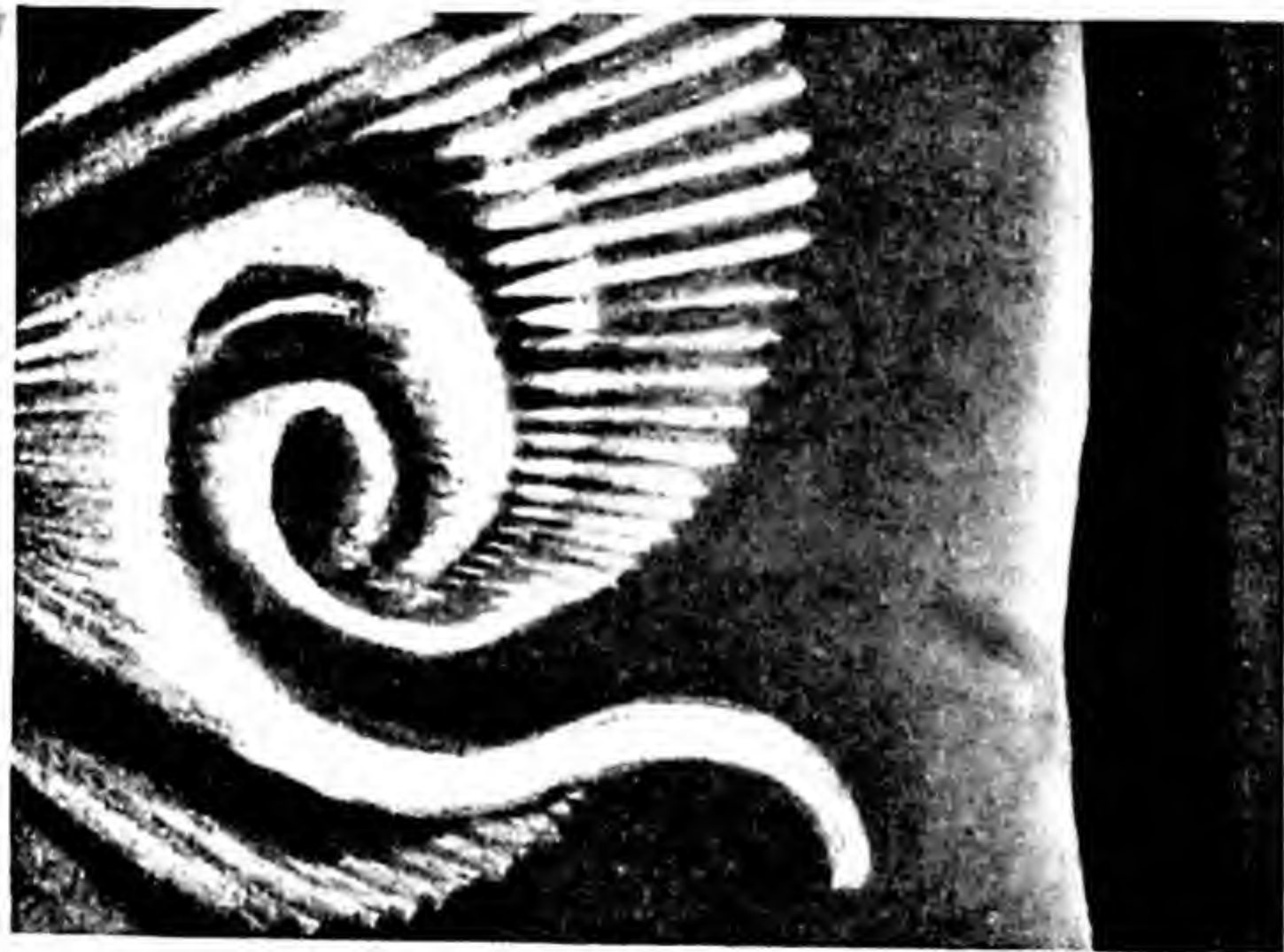
“The disk of the sun, as seen in a telescope, is by no means uniformly bright. Usually a number of dark spots are visible. The characteristic appearance of the solar surface can best be described by the word ‘mottled’.”

DONALD H. MENZEL

¹ The sun’s diameter is 866,000 miles.



Courtesy of Mount Wal in Observatory
 SUNSPOTS (page 3)



Courtesy of the Swedish Travel Bureau
 THE NORTHERN LIGHTS (page 5)

It is thought that major explosions on the sun are the cause of the occasional magnetic storms experienced on the earth, when radio and telephone transmission is interfered with, and particularly brilliant displays of the aurora borealis or northern lights are seen in polar and sub-polar regions, lighting up the sky in a remarkable fashion.

"Generally the lights are dancing overhead in an arc or arcs from east to west, always on the move, as if blown by gusts of wind. Usually the colour is the pale blue of an electric spark in a vacuum, but sometimes the whole sky is lit up in a painted dome, by every colour of the rainbow."

MICHAEL H. MASON

"Long after the grey twilight of midday had faded the brightness began. A luminous glow like sunrise shimmered low in the sky. It began in the mysterious North behind the frozen sea from whence the black storms came. The glow widened and sent bright tentacles feeling their way higher and higher between the stars. The tentacles became ribbons and banners, waving and folding and floating in a maze of coloured convolutions. The streamers shot to the top of the sky, glowing and weaving a weird fantasy, outshining the stars, then becoming so thin that the stars twinkled through the gauzy curtain."

A. R. EVANS

THE PLANETS.—There are nine planets revolving round the sun, pursuing separate paths or orbits many millions of miles away from the sun and from each other, and travelling at varying angles one to another. The planets are, in the order of their distances from the sun, Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto.

✓ *Mercury*, about half the size of the earth, is the planet nearest the sun which it circles once every 88 days. Astronomers think it keeps the same side facing the sun, and therefore one half of the planet is always extremely hot while the other half is perpetually frozen and dark. As it is near the sun, it can be seen by us only occasionally for some two hours after the sun sets or before it rises. It has been called the "morning star" and also the "evening star".

Venus is almost as large as the earth, and revolves round the sun once in 225 days. Its orbit is between those of Mercury and the earth. Like Mercury, owing to its nearness to the sun, Venus is seen best for a short time before sunrise and after sunset, and is also known as the "morning star" and the "evening star". Our 300 miles an hour aeroplane could fly from the earth to Venus in 10 years, but astronomers do not know what kind of a world the fliers would reach, for the planet is always veiled in clouds.

"No one on earth has even seen the surface of Venus. All that can be seen when a powerful telescope is turned in her direction is a very beautiful whitish-yellow object. For a long time it has been recognised that the whiteness of the planet together with the lack of visible surface features could mean only one thing—clouds."

CARL T. CHASE

The Earth.—Third in order of distance from the sun, about 93,000,000 miles from it, is the earth with its satellite the moon. The earth rotates on its axis once in 24 hours, and completes its journey round the sun once every $365\frac{1}{4}$ days. A full description of the earth is given later (p. 25).

The Moon is nearer the earth than any other celestial body, and our 300 miles an hour aeroplane could reach it from the earth after 33 days' flying through space.¹ Whether the fliers would care to alight is doubtful, for the moon is without water and air. Astronomers have proved this :

"When the moon passes between us and a star, the light from the star is cut off suddenly and the star disappears instantly, without the fading and other effects of refraction that would be observed if the starlight passed through a lunar atmosphere before being occulted."

CARL T. CHASE

The moon is much smaller than the earth ; it has a diameter of 2,162 miles, less than a third of that of the earth. Travelling at the rate of 2,287 miles an hour, it revolves round the earth once every $29\frac{1}{2}$ days, and it also rotates, taking as long to do so

¹ A society exists for the furtherance of journeying to the moon and planets, and has branches in England and America.



Courtesy of Mount Wilson Observat

A PORTION OF THE MOON (page 6)

as to circle the earth.¹ It shines with reflected sunlight, and according to its position, appears to us as a thin crescent, a full sphere of light, or any of the stages between the two, going through the variations during each period of revolution. The part of the moon's surface that faces us has been carefully observed and mapped.² The markings which look like a face, the "man in the moon", are high mountain chains, craters, valleys and canyons.

"We may not be entirely surprised at the mountain peaks and ranges, for we have often seen indistinct markings. We slip in an eye-piece of higher power and discover that the mountains are not greatly different from some that can be seen on earth, Vesuvius for example. There is no sign of water or vegetation."

CARL T. CHASE

Though we have never seen the other side of the moon, it is not likely to be different from the side we know except in its markings.

✓ *Mars* travels about 59 million miles farther away from the sun than the earth, and has two moons or satellites. The diameter of Mars is about half the size of the earth's. It has a day of the same length as ours but takes 687 days to go once round the sun. Many people have thought that this planet is inhabited, for on its surface can be seen through a telescope markings resembling vegetation, and lines so straight that they appear to be artificially made. Others believe that there is now no oxygen in the atmosphere of Mars and therefore no life on the planet. It would take our aeroplane from the earth 20 years to get there and find out.

¹ Though the moon rotates, we see only one half of it, for it always turns the same side to us. This is because it rotates once during every complete revolution it makes round the earth. This may be illustrated by someone standing near a spot on the floor and slowly circling it, facing it all the time. It will be observed that as a complete revolution round the spot is made, the person's body itself also once turns or rotates.

² Through the most powerful telescope (with 200-inch reflector), installed in 1940 at Mount Palomar in California, the moon is brought to within 25 miles.

"The most conspicuous features of the Martian landscape are the white polar caps, appearing alternately over the north and south polar regions as the seasons advance. There are also areas of ruddy hue, as well as darker areas that change in appearance with the seasons. The dark areas appear to be traversed by streaks or lines, which have been called canals."

CARL T. CHASE

Jupiter, the biggest planet, has a diameter of 90,000 miles, and is therefore more than 1,400 times the size of the earth. It rotates more rapidly than Mars or the earth, having a day and night of only 10 hours instead of 24, but owing to its much greater distance from the sun, its year is equal to 12 of ours. It is sometimes flecked with clouds and has no fewer than 11 satellites circling round it.

"In the midst of the satellites is the great planet, crossed by purple-brown stripes or bands which run parallel to the equator. Even as we look it is apparent that the planet has rotated slightly."

CARL T. CHASE

Saturn is almost as large as *Jupiter*. It also takes only about 10 hours to rotate, but nearly 30 years to revolve round the sun. *Saturn* is famous as the ringed planet, for around its equator, some 7,000 miles from it, are three shining rings each about 10 miles wide. They are believed to be formed of meteoric particles caused by the explosion of former satellites. Despite this *Saturn* still has 9 attendant moons.

"*Saturn* is not so brilliant an object as *Jupiter*, but we find him at last, shining among the stars with an orange light. The rings show up clearly."

CARL T. CHASE

The three outer planets, *Uranus*, *Neptune* and *Pluto*, discovered in 1781, 1846 and 1930 respectively, are so far away from the earth that they cannot be seen except through a telescope, and so far from the sun that they must be too cold for even gases, much less water, to remain unfrozen.

"As compared with the earth's distance from the sun, the distances of the outermost planets are enormous. Each square yard of *Pluto* receives, in round numbers, only a sixteen-hun-

dredth part as much light and heat from the sun as a square yard of the earth receives."

SIR JAMES JEANS

Uranus (with four satellites) takes 84 years, Neptune (with one satellite) 165 years, and Pluto 249 years to revolve once round the sun. Uranus and Neptune are about the same size, more than 60 times bigger than the earth. Pluto is smaller and is believed to be about as large as Mars.

"Pluto, swimming in the outer darkness, is faint and small, distinguishable from a faint star only by his motion."

CARL T. CHASE

THE ASTEROIDS.—These are small planetary bodies, the largest¹ having a diameter of 500 miles. They are thought to be the broken up remains of one or more large planets. There are over a thousand of them, and their paths lie between those of Mars and Jupiter, but they swing round the sun in an erratic manner and at times swerve from their courses and cross those of nearby planets. One of these wandering asteroids, the Reinmuth, came so close to the earth in 1937 that a collision was averted only by 5½ hours. It was, however, merely a mile in diameter, so that even if it had crashed into the earth it would not have caused the end of the world; the impact would have been similar to the fall of a large meteor.

COMETS.—Although several thousand comets exist in the solar system, they are seen only occasionally, for their paths form very elongated ellipses and carry them millions of miles into space after they have rounded the sun. A comet is a strange and awe-inspiring sight owing to the long shiny veil or "tail" that floats out from its bright starlike "head". The tail is thought to consist of small particles of meteoric matter, some of which constantly get "lost" as the comet pursues its journey through space and crosses the orbits of other planets. Astronomers think the tail is so thin that even if the earth were to collide with one, as seemed likely with Halley's Comet of 1910, our planet would

¹ Ceres, discovered in 1801.

simply pass through it without any result other than a shower of shooting stars and falling meteors.

METEORS.—Space is strewn with meteors, which are small and large fragments of solid matter, the remains of broken up comets, planets and stars. Some of these drift near to the earth and are then attracted by the force of gravity. When meteors enter the earth's atmosphere they appear as shooting stars, which are common sights in the sky at night and are specially brilliant in November and May. The great majority of meteors are tiny, and as they rush through the air, they become red hot and dissolve into invisible gas or dust. As millions of meteors yearly enter our atmosphere, thousands of tons of fine dust descend annually on the earth, which is therefore slowly getting bigger.

Occasionally meteors attracted by our planet are too large to break up, and reach the earth as lumps of iron and other metals and stone. Such meteorites have fallen in Central Australia, Central Arabia, South Africa, Greenland, and in eastern Arizona in the United States. The largest, the Arizona Meteor, made a crater nearly a mile wide and 750 feet deep, from which it has been estimated that it must have weighed at least a million tons ; it fell about 800 years ago, for there are 700 years old trees growing on the crater's edge ; many meteoric fragments have been found in the earth round about, and drilling is carried out every now and then in the hope of discovering the main piece.

The most recent fall of a huge meteorite was in 1908 in Central Siberia, fortunately in an uninhabited forest region, where it caused a fire over an area of 150 square miles. The roar as this meteorite rushed through the air and hit the earth was heard 2,000 miles away ; passengers on the Trans-Siberian Railway 400 miles away were deafened by the noise and saw a column of fire 12 miles high. This immense piece has not yet been discovered, although a group of craters averaging 50 yards in diameter and 12 feet deep were found, and the earth was dug to a depth of 30 feet. Possibly the meteorite was reduced to dust,

or after hitting the earth glanced off into space again, or it may be discovered in the future.

STARS

During the day we cannot see the stars that stud the sky because their light is overpowered by the rays of the sun, which is much the nearest star to the earth. Stars are seen most clearly at night when viewed through an atmosphere free from moisture. If there is much water-vapour in the air the stars appear dim and twinkling and far away. Therefore in Britain stars are observed best on frosty nights when the air is dry. In such places as Egypt, Arabia, India and California, where skies are often cloudless, more stars can be seen, and they appear large and brilliant.

"No one who has not been there has any idea of the perfect beauty of the Indian night. The sky is so serene, the great planets so wonderfully brilliant, the stars like diamond dust sprinkling a heavenly robe."

D. KING MARTIN

"The Arab is trained from early youth in the observation of the stars, and soon learns to find his way by their unerring guidance over the pathless desert and the trackless sea. In the pure clear atmosphere in these regions the stars that shine so brilliantly are truly invaluable in enabling him to direct his nightly course."

S. B. MILES

Under good conditions, a person with normal eyesight sees several thousand stars, but with the aid of telescopes, astronomers have mapped over a thousand million.

CONSTELLATIONS.—When we look at the stars we find that they seem to be arranged in groups. These groups or constellations have been named, and the stars in each group given special names. As the earth rotates and revolves different sets of stars are seen, some of which appear to rise and set as the sun does.

In the Northern Hemisphere one of the easiest constellations to find is the Great Bear (or Ursa Major). It consists of four stars forming the four corners of a square (the Bear's body), and from one of the corners of the square three more stars stretch out

in a curved line (the Bear's tail). The two outer stars of the square are always in line with the North Star, the mariner's guide, which is almost directly above the North Pole.¹

An even more conspicuous sight in the sky than the various constellations is the Milky Way, a bright arc formed by densely crowded stars extending right across the sky.

"The richness of stars in the Milky Way is striking. The white lane appears through a telescope as it really is, a huge cloud of stars, many being far superior to our sun." CARL T. CHASE

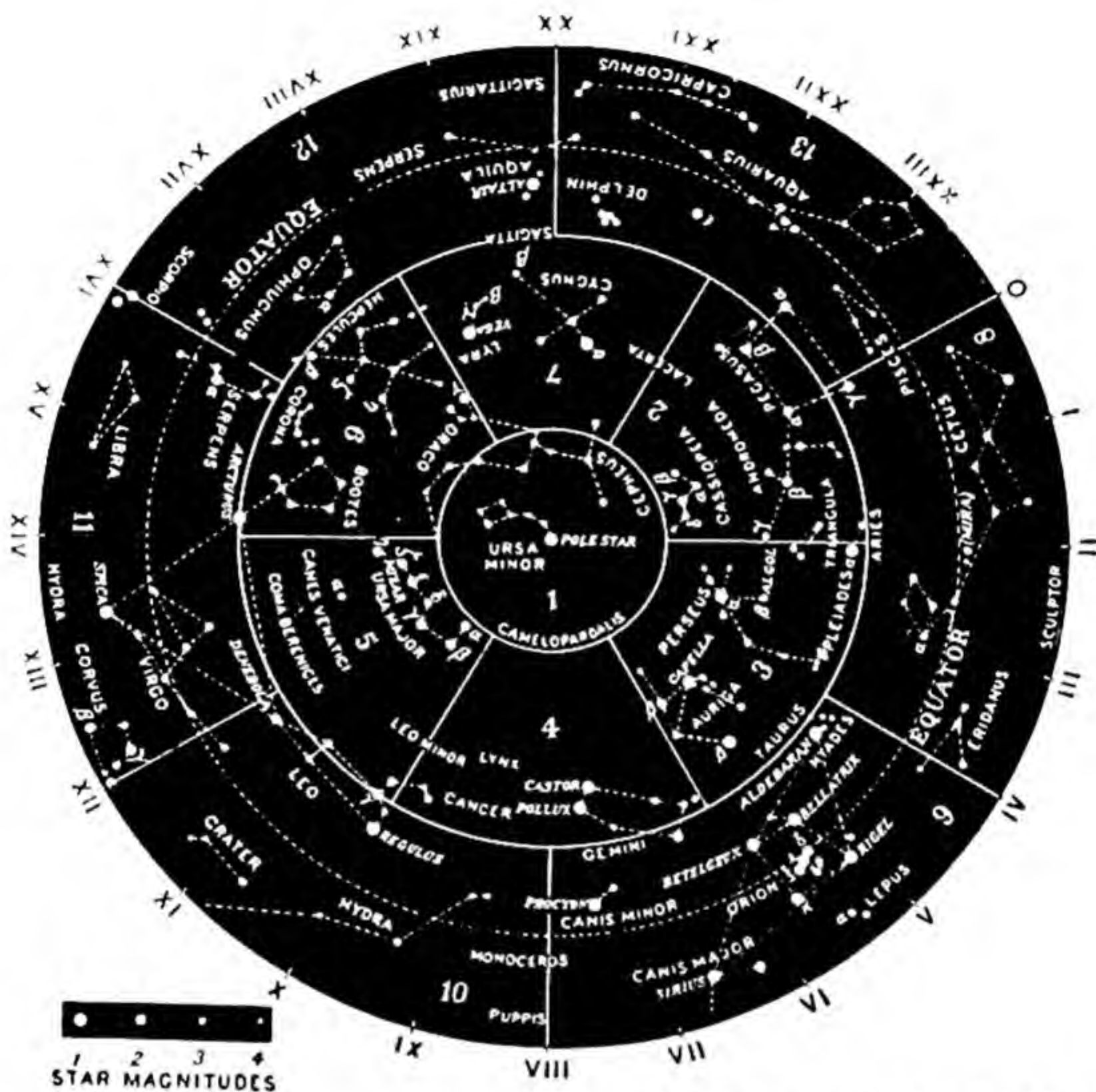
DIFFERENT KINDS OF STARS.—Stars are of different colours, such as red, orange, yellow, white and blue, and the colour is thought to depend on the temperature of the star.

"Sirius, the dog star, shines with a piercing blue-white gleam. Betelgeuse and Aldebaran are redder. As seen through the telescope the colour of each star becomes more vivid." C. T. CHASE

Stars send out varying amounts of light and heat, the amount depending on their size and temperature.

"The most luminous star known is S. Doradus, with 300,000 times the luminosity of the sun, while the least luminous is Wolf 359, with only a fifty-thousandth part of the luminosity of the sun. If S. Doradus is a lighthouse, Wolf 359 is something less than a firefly, the sun being an ordinary candle. If the sun suddenly started to emit as much light and heat as S. Doradus, the temperature of the earth and everything on it would run up to about 7,000 degrees, so that both we and the solid earth would disappear in a cloud of vapour. On the other hand, if the sun's emission of light and heat were suddenly to sink to that of

¹ The solar system revolves once every 26,000 years around a centre near the North Star, and as the earth moves with the solar system, its axis points in turn during each solar revolution to various spots on the circumference of a small circle surrounding this centre. At present the earth's axis is pointing to the North Star, called also the Pole Star or Stella Polaris, in the constellation Ursa Minor. 6,000 years ago, when the Great Pyramid of Egypt was built with an aperture pointing to the Pole Star, the latter was Thuban in the constellation Draco. In about 13,000 years the Pole Star will be Vega in the constellation Lyra. 26,000 years from now it will be North Star once more. This variation in the direction of the earth's axis is known as its precession.



From Sir James Jeans' "The Stars in Their

THE NORTHERN SKY

The division of the sky into
astronomers for mapping and
stars, just as lines of latitude
graphers to determine the



Courtesy (Cambridge University Press)

THE SOUTHERN SKY

sections is a device used by locating constellations and longitude enable geo-position of places on the earth.

Wolf 359, people at the earth's equator would find that their new sun only gave as much light and heat at mid-day as a coal fire 200 yards away ; we should all be frozen solid, even the earth's atmosphere being frozen solid around us." SIR JAMES JEANS

There are stars of every size from " giants " to " dwarfs ". The giants are unbelievably large. Betelgeuse, in the constellation of Orion, is huge enough to cover the entire *orbit* of the earth. Antares in Scorpio, the largest star known, is 100,000,000 times the size of the sun.

" These stars must be exceedingly tenuous. We probably ought to think of the huge size of Antares as being due mainly to an enormously extended atmosphere of very tenuous gas."

SIR JAMES JEANS

Compared with these, the dwarfs, whose light is very faint, are indeed tiny.

" The smallest known star is just about as large as the earth."

SIR JAMES JEANS

But though relatively small, these dwarfs weigh almost as much as the giants, and must therefore consist of very dense matter : enough of their matter to fill a matchbox might weigh two tons. A white dwarf accompanies the bright Sirius.

" The system of Sirius consists of two very dissimilar stars. Sirius A, which appears as the brightest star in the sky, is white in colour. Its luminosity is about 26 times that of the sun. The faint companion, Sirius B, is one of the most interesting stars in the sky. It is of nearly the same colour as Sirius A, but emits only a three-thousandth part as much light. Yet Sirius A weighs only three times as much as Sirius B although having more than 20,000 times its volume. The average cubic inch of Sirius B contains several hundredweight of matter."

SIR JAMES JEANS

STAR DISTANCES.—We see all the stars, even the giants, as mere pin-points of light, because they are very far from us.¹

¹ It should be noted that owing to the varying distances of the stars from us, the following four different stars appear to us more or less alike as mere pin-points : the largest known star, the most luminous star, the brightest star seen in the night sky, and the star nearest the solar system.

"Recent measurements show that the nearest stars are almost exactly a million times as distant as the nearest planets. A telescope exhibits a planet as a disc of appreciable size, and an eye-piece which magnifies 60 times will make Jupiter look as large as the moon. Yet an eye-piece which magnifies 60 times, or any greater number of times, can never make a star look as large as Jupiter. Because of the great distance no magnification within our command causes any star to appear as anything other than a mere point of light."

SIR JAMES JEANS

It would take our 300 mile an hour aeroplane nine million years to reach the star nearest the solar system, Alpha Centauri,¹ for it is more than 23,462,784,000,000 miles distant from the earth. To obviate the use of such long and unwieldy figures, star distances, instead of being given in miles, are calculated by the length of time their light takes to reach us. Light travels at the rate of 18,000 miles a second, so that a light year is equal to 5,865,696,000,000 miles. Thus Alpha Centauri is 4 light years away from us, Sirius 10, Antares 163, and the most distant stars in our universe are 250,000 light years away. This means that the lights we now receive from these stars must have started on their journey to us years ago; in some cases before we were born, in others before Columbus reached America, others before the Pyramids were built, and still others before mankind appeared on the earth; therefore what we see to-day happening to the stars was in reality all over and finished with ages ago.

THE GALACTIC SYSTEM AND OTHER ISLAND UNIVERSES.—The assembly of millions of stars in our universe is known as the Galactic System. The shape of the Galactic System in space has been variously likened to that of a watch, a bun or a wheel, towards the edge of which our solar system is set. There are, however, other stars and star groups outside our universe.

¹ It may be mentioned that calculations of any kind about travelling through space are merely theoretical. In reality aeroplanes and balloons can fly only within the limits of the earth's atmosphere. Machines that may be built in future to penetrate outer space would have to face the problems of overcoming gravitation and resisting millions of hurtling meteors and invisible cosmic rays.

"The Galactic System, with its hundreds of millions of stars, no more contains all the stars in space than one house contains all the inhabitants of Great Britain. There are millions of other houses and millions of other families of stars." SIR JAMES JEANS

With the aid of their most powerful telescopes, astronomers have found other universes or nebulae that appear through a telescope as concentrated clusters of bright pin-points.¹ The infinite distances between other universes and our own cause them to seem to us as specks of light set closely together or as "island" universes. In reality each universe, like our own, fills so vast a place in space that billions and trillions of miles separate the millions of stars that compose it.

"Empty Waterloo Station (one of the largest railway stations in London) of everything except six specks of dust, and it is far more crowded with dust than space is with stars." SIR JAMES JEANS

THE UNIVERSE IN SPACE.—There is nothing stationary in space. The earth rotates on its axis at the rate of about 1,000 miles an hour², revolves round the sun at the rate of 60,000 miles an hour, circles with the rest of the solar system about a point in space near the North Star at the rate of 500,000 miles an hour, and travels with the whole Galactic System at the rate of about 900,000 miles an hour. Those of us anxious to travel, or envious of the speeds attained by racing motorists and airmen, might comfort ourselves by the knowledge that while sitting still and reading these lines we are journeying great distances and being carried at tremendously faster speeds than are ever achieved by the fastest motor-cars and aeroplanes on the earth itself.

The curious may wonder how the different members of the universe are held in space and why stars and planets do not lose

¹ One of these nebulae can just be seen with the unaided eye in the constellation of Andromeda. The term nebula is also given to certain smaller types of clusters of light within the Galactic System; one consists of a circular mass of luminous vapour surrounding a single star, another a trailing cloud of gas stretching among the various stars of some constellations such as the Pleiades.

² The earth rotates at this speed at the equator, and the rate lessens from there to the poles, where there is no appreciable rotatory movement.



Courtesy of Mount Wilson Observatory

NEBULA IN ANDROMEDA : " AN ISLAND UNIVERSE " (page 18)

their way. Their movement holds them up, just as a person swimming does not sink to the bottom of the sea, or a top while spinning can balance on its point. They keep to their paths in space through gravitation. This is the force that pulls us back to the earth however high we jump, that causes water to flow from a higher to a lower level, that prevents aeroplanes from flying off the earth. All masses of matter exert this attraction on one another, and so star pulls on star, planet on planet, and each body finds its equilibrium and keeps its orbit and place in space.

THE BEGINNING AND END.—There have been many conjectures about the beginning and end of the world. An interesting point is that nowhere else in the universe, according to some modern astronomers, is there anything comparable to the solar system, and therefore the earth and mankind are unique creations; but according to others, many of the stars in the universe have attendant planets, and possibly there are animate beings on them.

As to the earth's beginning, one of the latest suggestions of scientists is that before our solar system existed, the sun, larger and fiercer, passed near another star which caused such great storms on its surface that an immense jet from it was pulled off into space, and this divided into large and small fragments and formed the planets. The planets then gradually cooled, according to their sizes and distances from the sun, their various substances mixing and changing as meteoric dust fell and settled on their surfaces. During the cooling process of the earth, it is thought by some that a large wisp tore away to form the moon, and the Pacific Ocean is pointed out as the hollow left behind. As the earth further cooled the metals and rocks solidified, and the water-vapour fell as rain and filled the oceans. *Æons* later life began.

There have been also many suggestions as to the probable end of the world. According to some, the sun may slowly cool, and freezing mankind be forced to emigrate, possibly to Venus. According to others, the sun may flare up into new activity, and heat driven men seek refuge in Mars. According to still others

the sun may again pass a giant star and the solar system be re-formed. But the most recent theory inclines to the view that long before any of the foregoing happens, the oxygen in our atmosphere will be used up, and mankind will perish. Practically all scientists are agreed, however, that the earth was born about two thousand million years ago, and it has at least as long a future.

“ If the solar system is left to a natural course of evolution, the earth is likely to remain a possible abode of life for something of the order of a million million years to come. This is some 500 times the past age of the earth, and more than a million times the period through which humanity has so far existed on earth.”

SIR JAMES JEANS

EXERCISES

1. In what ways are we dependent on the sun?
2. Name the nine planets, and state one fact about each.
3. What are the apparent markings on the moon?
4. Explain shortly what is meant by : aurora borealis, satellite, asteroid, comet, meteor, constellation, the galactic system, a light year.

5. Rewrite, filling in the missing words :

Our universe, known as the — —, consists of — of stars and star-groups. To us the nearest and most important star is the —, around which the earth and eight other—revolve, forming the — system. The earth is — among the planets in order of distance from the sun, the two nearer ones being — and —. As regards size the earth is larger than —, — and —, about the same size as —, but smaller than —, —, — and —. The earth has one satellite, the —, which makes a complete revolution round it once every — —. The — is our nearest neighbour in the universe. If aeroplanes could travel through —, they would reach the moon after a — continuous flying, but would take — — to get to —, our second nearest heavenly body.

COMPOSITION

A Trip to the Moon.
The Stars.

LOCAL STUDY

Study the stars and see which of the constellations you can distinguish. Reference may be made to the star-maps on pp. 14-15.

HANDWORK

Draw a sketch-map to show the chief constellations you can see from your home, and put the date and time on the map. Prepare another map after a month, and compare the two.

DEBATE

In a hundred years' time people will travel through space as easily as they now cross the oceans.

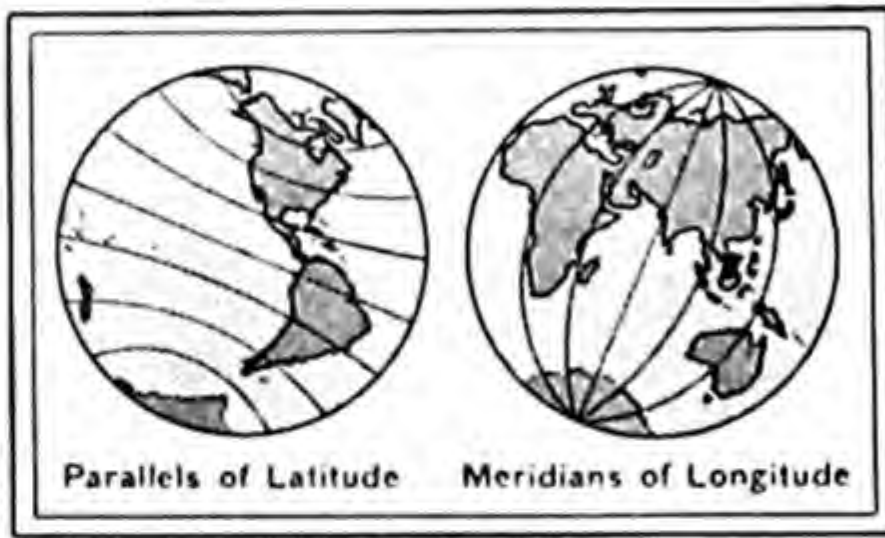
CHAPTER TWO

GEOLOGICAL CHART

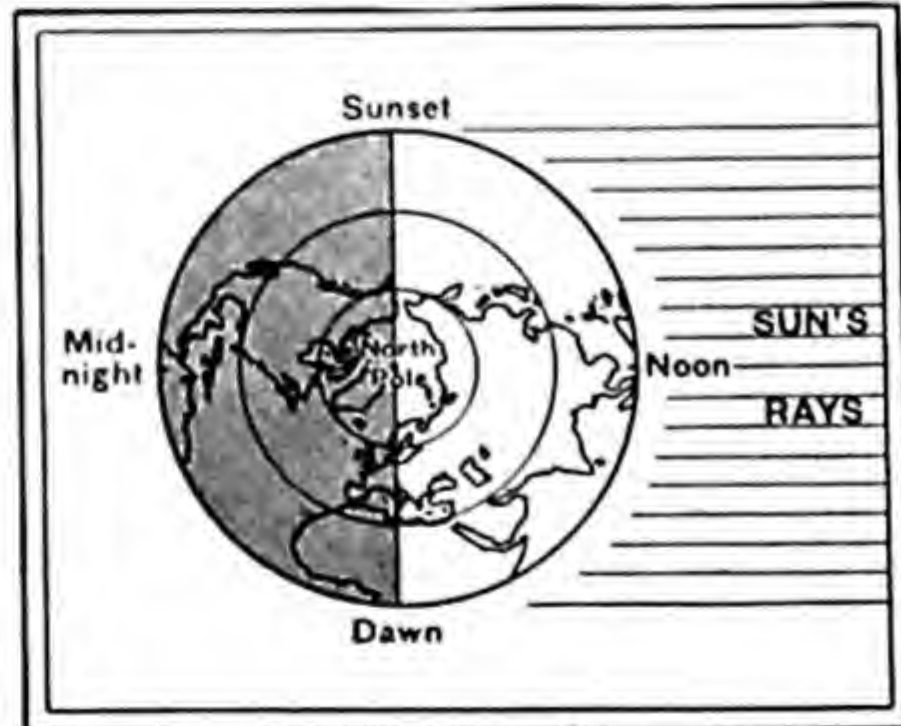
PERIOD		EVENTS	LIFE
1 million years ago	Quaternary	Glacial Age.	Man
80 million years ago	Tertiary	Alpine Earth Movements.	First men, horses, elephants. Archaic animals (mammoth etc.)
	Secondary	Altaid Earth Movements.	First birds and mammals. Giant Reptiles.
200 million years ago	Primary	Formation of Coal Deposits. Caledonian Earth Movements.	First reptiles, insects and land creatures. Sponges, corals, worms.
500 million years ago			

Pre-Cambrian Era.
One-celled plants and animals.

2000 million years ago



LATITUDE and LONGITUDE



DAY AND NIGHT

CHAPTER TWO

THE EARTH

THE SHAPE OF THE EARTH.—Like all other heavenly bodies, our planet is spherical in shape. We can prove this by travelling round the world by sea and air. One may sail from London westwards over the Atlantic Ocean, pass through the Panama Canal, cross the Pacific Ocean, and return from the east through the Indian Ocean, Red Sea, Suez Canal, Mediterranean Sea, Strait of Gibraltar and the Bay of Biscay. Airmen have flown east from New York to Moscow and Japan, continued on to California, and finally regained New York from the west. Other fliers have gone from Moscow to San Francisco via the North Pole.

There are other proofs that the earth is round. During an eclipse of the moon, when the earth is between the moon and the sun, its shadow on the moon is circular. The sailor on the open ocean and the traveller crossing flat country both find the horizon around them forming a circle. A person standing on the sea-shore and looking out to sea awaiting the coming of a liner, sees first its funnels and then the vessel itself "climb" over the horizon. If three posts of the same length are set in a straight line across flat country, three miles apart from each other, an observer from either end will find that the middle post appears taller than the other two. This last experiment was first carried out in the 19th century and is known as the Bedford Level.

However, we are not conscious of living on a round world. At the selfsame moment a boy in England and his cousin in New Zealand, walking on the opposite "sides" of the world, both feel the earth below their feet and the sky above their heads. This is partly because compared with the size of the earth we are very

tiny creatures¹, and partly because of the effect of the force of gravity on us. Gravitation keeps all the huge bodies of the universe in their places.² It persuades us pygmies that the earth which pulls us back to it at every step is always down below us.

Although we go on journeys round the earth and say the world is round, the earth in reality is not a perfect sphere.³

"Nobody seems quite to know what is the exact shape of the earth. It certainly is not a true sphere. It is called a geoid, which means earth-shaped. 'The earth is earth-shaped,' said Sir John Herschel, not very helpfully. Sir James Jeans says it is pear-shaped, and Professor Gregory 'like a badly made peg-top'. It is recently revealed that the earth is like an orange that has been gently and delicately—sucked. A little sucked, no more.

- * ¹ Even if our feet were a mile in length, we would still find difficulty in feeling the curve under us: so immense is the earth. 5,280 men standing behind each other in a line stretch only one mile. The whole population of the earth have standing room in an area less than 74 square miles, or a place about half as large as London. A sixpence placed on an ordinary school globe will lie practically flat on the surface, leaving no perceptible space under it despite the roundness of the globe; yet the sixpence takes on the globe well over a thousand times more room than we take on the earth.

² See p. 20.

³ Certain statements though allowable are misleading, and when reading them care should be taken that they do not cause misunderstanding. The earth has an uneven surface because of the mountains and valleys, and is slightly flattened at the poles and bulging at the equator, though it is customary to say it is round. We describe the "rising" and "setting" of the sun although in fact that is an illusion. There are also other statements which though accurate in themselves nevertheless may be misinterpreted, unless their significance is thoroughly grasped. For instance, the diameter of Mars is about half the size of that of the earth, but this does not mean the earth is only twice as big as Mars. Maps and diagrams may also give rise to confusions. On some maps of the world America is seen farther away from Japan than from India, but actually America is nearer to Japan than to India. Again, on some diagrams of the relative distances of the planets from the sun, the straight line in which the planets are placed does *not* suggest the proportionate distances between them; the planets are often in positions more distant from each other than from the sun; diagrams of this kind indicate only the planets' relative distances from the *sun*, and the proportionate distances between their *orbits*.

It is not merely flattened at the Poles, but flatter at one pole than the other, and the equator is not even a circle ; it is an ellipse."

CYRIL HALL

There is a difference of 27 miles between the earth's equatorial diameter (7,926 miles) and its polar diameter (7,899 miles). Its comparison with an orange should be received with caution because we usually think of an orange in an upright position, and such is not the way in which the earth rotates and revolves round the sun. If a rod were passed through the earth from the North Pole to the South Pole to represent the polar axis, it would be found that the rod was not at right angles to the planet's orbit, but inclined at an angle of $23\frac{1}{2}$ degrees from the vertical.¹ Thus as the earth journeys along its path, at one period in the year the North Pole points towards, and at another period away from, the sun. We shall see later how this inclined axis, due to the attraction between the Pole Star and the North Pole, has a great influence on the earth's climate (p. 39).

THE HISTORY OF THE EARTH.—Practically nothing is known about the conditions in the world when the earth was "young" during the first 1,500 million years after its cooling. But a great deal has been discovered of its history during the following period, the last 500 million years. Geologists have reconstructed pictures of what happened in past ages by studying rocks and fossils.

Fossils are the solidified remains of ancient living matter that have been preserved from decay and decomposition. There are fossils of plants, fish, insects, birds, animals and men, and these

¹ The inclined axis and bulging equator are examples of the many mathematically imperfect things in the universe. The orbits of all the planets are slightly irregular as regards distance from the sun, and are at different angles one to another so that they cannot be considered concentric ellipses. The earth does not keep to its path ; it is gradually receding from the sun at the rate of about $\frac{1}{4}$ inch a year. The moon appears to deviate from its predicted course by a few seconds each year. The earth does not take exactly 24 hours to rotate, but 23 hours, 56 minutes, 4 seconds, etc.

have remained intact in a solidified condition for many centuries because they were suddenly buried in ice-fields, caves, coalseams, peat beds, quicksands, asphalt lakes, the dry sand of deserts, the mud carried by rivers, and even, in the case of insects, in drops of sticky resin which later hardened into amber.

The development of the earth as surveyed by geologists covers only a small part, about a quarter, of the earth's entire existence. This quarter has been divided into four main periods, each of which lasted millions of years, and was marked by widespread climatic changes and upheavals in the structure of the earth's surface.

First came the Primary period or Palæozoic era, when the "Caledonian" earth movements took place and great mountain ranges were formed.¹ During succeeding ages these high mountains gradually wore down, and to-day all that is left of them are comparatively low and rounded highlands. Examples are the highlands of Scotland and Scandinavia, the Appalachians of the United States, the Laurentian Highlands of Canada, and the uplands of Central and Western Australia. It was in these days that the earliest forms of life appeared: at first primitive plants, then sea-creatures such as sponges and corals, followed by the earliest fish, and later the first land animals, scorpions and worms. Towards the end of this period great areas in North America, Europe, Asia, Australia and Antarctica were covered with swampy forests, where strange plants and trees flourished as vigorously as do now the equatorial forests. In these surroundings reptiles and insects made their first appearance. To-day those one-time forests, after being overlaid by mud and rock and soil for millions of years, exist as our coal deposits, their trees and plants having been transformed into coal by pressure and heat.

Conditions changed in the world and the Secondary period or Mesozoic era began. Movements in the earth's crust gave rise

¹ According to the latest theories, the movements were due to disturbances in the magma (the core of the earth) owing to its cooling, or to the drift or rise and fall of continents, or to electrical influences coming from outside the earth and affecting the magnetic poles.

to the "Altaid" mountain systems.¹ Remains of these mountain chains, worn down but less so than the Caledonian folds, exist in the uplands of south-west England, Brittany and the Central Plateau of France, the Vosges, Harz and Bohemian Mountains of Central Europe, the Urals and the Altai of Asia. In this era appeared the first birds, and the giant reptiles such as the dinosaurs, iguanodons, and the brontosaurus whose reconstructed skeletons can be seen in some museums. The biggest dinosaurian reptile so far discovered is 16 feet high and 70 feet long.

"We handled many dinosaur remains, but what interested us most were the sections of coral reef and the splendid fish fossils which the Gobi sand has jealously hidden since the days when it formed an ocean bed."

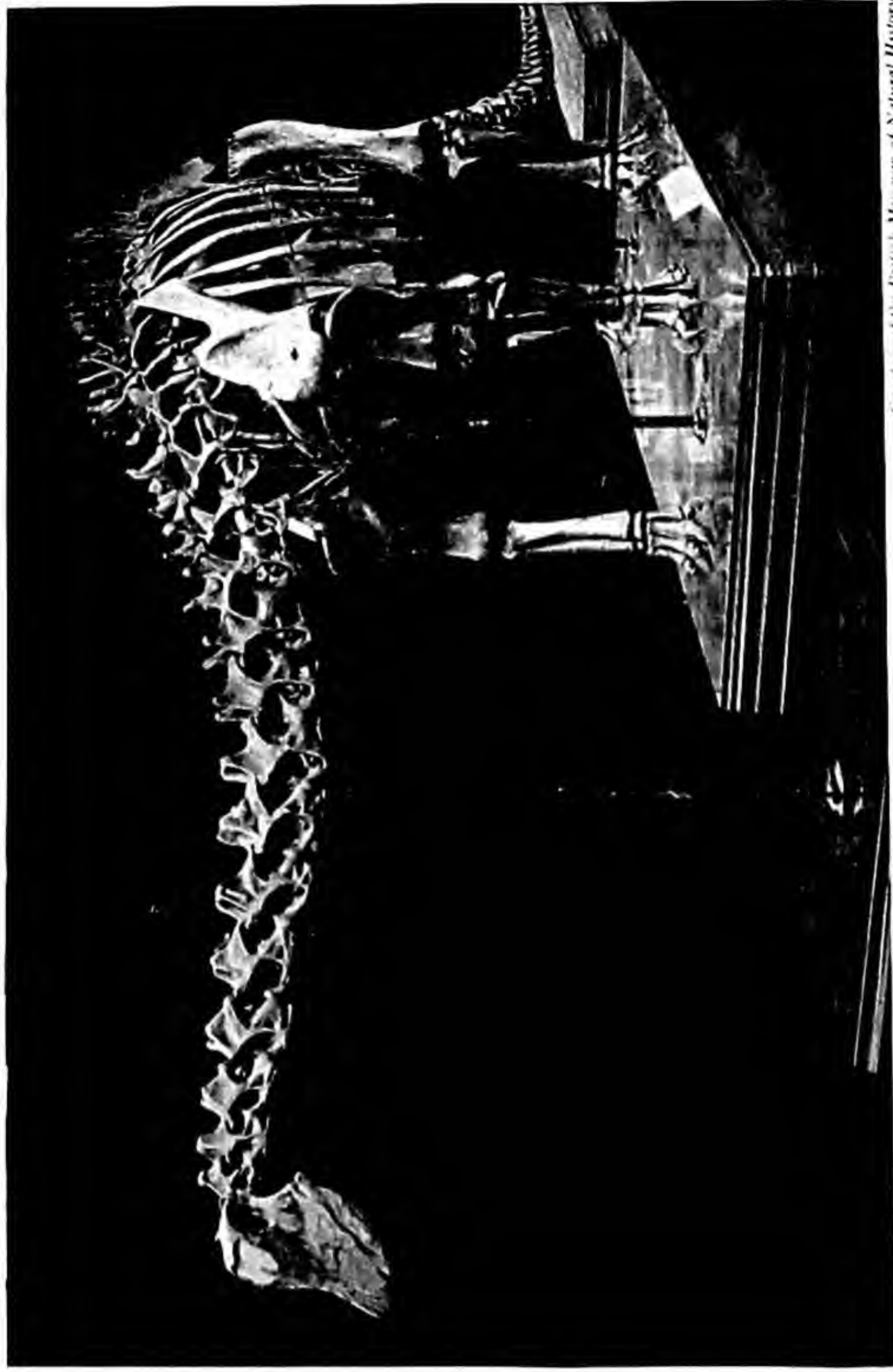
E. FRENCH, M. CABLE, F. FRENCH

During the Third or Tertiary period, the giant reptiles were succeeded by the ancestors of our present animals, which were very tiny, the forerunner of the horse standing 16 inches high, and that of the elephant only 25 inches. Mammals appeared that are now extinct, such as the hairy mammoths and sabre-toothed tigers that roamed in the region to-day called Britain. Possibly the first human beings lived in this period, for the "Java man", the oldest fossilised man yet discovered, is believed to have lived much more than a million years ago.

In the same period occurred the Alpine earth movements, when the present great mountain ranges were formed, the Rockies and the Andes, the Himalaya and the Alps, with their radiating chains. Before the end of this era, animals, birds, fish and insects began to develop the appearances and habits they have to-day, and human beings started to use fire and practise burial; many fossil men of this time have been discovered, and are known as the "Neanderthal men".

Then came the Ice or Glacial Age when large areas of the world were covered with glaciers. Ice-sheets spread over the whole of northern Europe, extending in Britain as far south as

¹ Also called Armorican and Hercynian.



Courtesy of the British Museum of Natural History

DIPLODOCUS: A DINOSAURIAN LAND REPTILE (page 29)

London, in central Europe almost joining up with those of the Alps. They stretched over North America from the Arctic Ocean to New York, and also over parts of South America and south-west Australia, while in Asia the Himalayan glaciers reached into China. As thousands of years passed, the ice-fields gradually melted and left behind mere remnants of themselves—the glaciers which exist to-day in the highest and coldest regions of the world, in the Himalaya, the Alps, the Rockies and the Andes, and in Norway, Iceland and Antarctica.

Then about one million years ago, in the Fourth or Quaternary period, the type of man who has been named "*homo sapiens*" appeared. From this time onwards the earth began to be more and more densely peopled, civilisations arose, and the world became as we know it to-day.

"How lucky we are to live in a period of the earth's history when its scenery is interesting. The facts of geology show that through perhaps three-quarters of geological time the lands have lain at a low level, planed down by the forces of denudation into dull undulations with slow meandering streams. Only at long intervals has come rejuvenation. Geographical forces which we do not fully understand have come into play. They have raised the continents, crumpled up their edges to build enormous mountain-chains, released volcanic forces. We live just after one of these rejuvenating revolutions. Through this accident we are privileged to possess our Alps and Rockies, our Himalaya and Andes ; to this we owe our rift valleys, our canyons, our mighty volcanoes ; it is this we have to thank for the scooping of ice that formed the fiords and dug down to make a land of mountains out of an old plain, as in Scotland, and the moraine-damming of valleys that made us our biggest and our loveliest lakes—Como and Superior, Geneva and Windermere."

JULIAN HUXLEY

THE INTERIOR OF THE EARTH.—Little has yet been discovered about the interior of the earth, which is technically known as the barysphere. We know that rock poured forth by volcanoes during eruption is molten. Also at the bottom of deep

mines it is so hot that miners wear scanty clothing even in the middle of winter.¹

It is thought that the barysphere consists of a series of different layers. In the centre is the magma, made (as meteors are) of a mixture of iron, nickel and stone, present at extremely high temperatures. On the magma rest layers of rock, 15 to 20 miles thick, supporting the continents, and other thinner layers which uphold the ocean floors. It is also believed that the continents rise and fall and even move about, floating on the magma, and that originally the continents formed one great mass and later gradually shifted apart.²

Though this seems fantastic, some facts support it : from the shape of South America it is obvious it could be fitted in with Africa, while North America and Greenland fit in with Europe ; various mountain ranges which are alike in structure appear to be continuous from continent to continent³; similar plants, animals and civilisations are known to have existed on different continents in days when there was no communication of any kind between them.⁴ The theory offers also explanations of many puzzling features in the earth's history, such as the recurrent disturbances which lead to the formation of mountains,⁵ and the

¹ The temperature rises about 3° F. for every 200 feet descended.

² " It can hardly be doubted that there is enough evidence to warrant our retaining continental drift as a working hypothesis."—S. W. Wooldridge and R. S. Morgan, *The Physical Basis of Geography : An Outline of Geomorphology*, London, 1937.

³ The Appalachians of North America and the highlands of Scotland ; the Appenines of Italy, the Atlas Mountains of North Africa and the Sierra Nevada of Southern Spain ; etc.

⁴ Some geographers have held that this occurred because of prehistoric " land bridges " connecting the continents, but it is unlikely that the ocean depths have altered (see p. 111).

⁵ According to geologists, Africa, Arabia and the peninsula of India pushed northwards, and exerted pressure until the land was heaved up to form amongst other mountains the Alps of Europe and the Himalaya of Asia ; and the Americas floated westwards until their movement was arrested, and their western edges piled up into the Rockies and Andes ranges.

great climatic changes that have occurred in many areas.¹ Without continental drift it would be difficult to account for the fossilised remains of plants in the Antarctic, which is to-day an ice-covered desolate waste.

"At Lat. 87° S., Long. $152^{\circ} 30'$ W., on the summit of an 8,200 ft. mountain, the party stood within 207 statute miles of the South Pole. So near the Pole, in moraines and gulleys around the mountain and on the summit itself, they came upon numerous fossils of plant leaves, perfectly formed plant stems, and even fossilised tree trunks up to 18 inches in diameter. In the sides of the mountain, Blackburn counted 15 seams of coal, interbedded with shales and limestones." *C. H. Munn* RICHARD E. BYRD

THE SURFACE OF THE EARTH.—The earth's surface is made up of great land masses separated by vast oceans. The main land areas are the continents of Europe, Africa, Asia, Australia, North America, South America, and Antarctica. The chief oceans are the Pacific, which lies between Asia and the Americas; the Atlantic, separating the Americas from Europe and Africa; the Indian Ocean, which extends between Africa and Australia, and merges into the Southern or Antarctic Ocean surrounding Antarctica; and the Arctic Ocean that covers the north polar regions.²

There is much more water than land on the earth, for oceans cover three-quarters of the globe, and land only a quarter. And whichever way the earth is divided, the land is disproportionately

¹ At one time much of Europe and North America was covered by great ice-sheets, and at another period the trees and plants which now form the coal-fields in northern Europe grew under tropical conditions. If the lands of the earth moved towards the poles their climate would become very much colder, and if they then crowded towards the equator their climate would become tropical. According to another theory, however, the climatic changes in some areas have been due to the variation in the tilt of the polar axis, which is claimed to have slowly deviated during the last 5 million years from an inclination of $35\frac{1}{2}^{\circ}$ to $23\frac{1}{2}^{\circ}$.

² Approximate areas in millions of square miles: Europe $3\frac{1}{4}$, Africa $11\frac{1}{4}$, Asia 17, Australia 3, North America 9, South America 7, Pacific Ocean 68, Atlantic Ocean 41, Indian Ocean 29.

placed. For instance the Eastern Hemisphere, containing Europe, Africa, Asia and Australia, has a much larger land area than the Western Hemisphere with only the Americas. The Northern Hemisphere (the area north of the equator) possesses three times as much land as the Southern Hemisphere, for the land masses tend to be triangular in shape tapering towards the South Pole. Indeed it is possible to divide the earth into "land" and "water" hemispheres; the one consisting of most of the land of the world with the British Isles at its centre, the other containing only southern South America, Australasia and Antarctica.

LINES OF LATITUDE AND LONGITUDE.—Geographers settle the proportionate sizes of continents and oceans, and fix the positions of countries and towns, by means of a network of lines called lines of latitude and longitude.

The network is based on the most easily fixed spot of the earth's surface, the North Pole; this is not affected by the rotation and revolution of the earth, for it always points to the North Star. The point exactly opposite the North Pole, on the other side of the earth, is the South Pole. A circle drawn round the earth equidistant from the poles is the Equator, which divides the world into two halves, the Northern and the Southern Hemispheres. Other circles drawn parallel with the equator on both sides of it are marked by degrees, those on the north from 0° at the equator to 90° North at the North Pole, and those on the south from 0° at the equator to 90° South at the South Pole. These circles are known as *parallels of latitude*, each degree representing roughly 69 miles of the earth's surface.

Another set of circles are drawn from the North to the South Pole, crossing the parallels of latitude. These north to south lines are called *meridians of longitude*. At the equator each degree of longitude covers about 69 miles, but from there, instead of running parallel to each other, the lines converge till they meet at the poles; at the latitude of London each meridian covers only 43 miles.

Unlike the parallels of latitude, any one of the degrees of longitude could be considered prime meridian 0° , but usually the one that passes through Greenwich, a district of London, is taken as Longitude 0° , and where it enters the English Channel at Peacehaven, south of Greenwich on the coast of Sussex, an obelisk indicates the spot.¹ East and west of Greenwich the meridians are numbered from 1° to 180° , the latter running through the centre of the Pacific Ocean.²

All the meridians are of equal size, whereas the parallels of latitude, immediately after the equator, get smaller and smaller until they are reduced to points at the poles. The meridians and the equator, whose centres are the earth's core, are known as *great circles*, the parallels of latitude other than the equator being known as *small circles*.

On most globes and maps only every 10th or 15th or 20th meridian and parallel of latitude is given, but on those where small areas are sketched on comparatively large scales, such as the Ordnance Survey Maps, degrees and fractions of degrees are shown. Each degree (1°) is divided into 60 minutes ($1' - 60'$), and each minute into 60 seconds ($1'' - 60''$).

It should be noted that these lines of latitude and longitude are merely imaginary, enabling us to find easily any spot on our spherical planet. The indexes of atlases make use of them : after each place-name is given the page of the map on which it appears followed by its latitude and longitude. For instance, New Orleans is situated at Latitude 30° North of the Equator and Longitude 90° West of Greenwich. Madras is at Latitude 13° North and Longitude 80° East. If a ship sends an S.O.S. from Lat.

¹ On top of the obelisk is a globe with a pointer facing the North Star. The shadow of the pointer falls on the prime meridian at noon.

² The system of numbering both the meridians and the parallels of latitude is based on the 360 degrees of a circle, which represents approximately the shape of the earth. The meridians each side of Greenwich, numbered from 1° to 180° , cover half of the earth, and the two sides together total 360° . The parallels of latitude are numbered $1^\circ - 90^\circ$ from the equator to either of the poles, which is a quarter of the earth, and four arcs of 90° make a circle of 360° .

15° S. and Long. 140° E., an Australian vessel will sail to its help and know exactly where in the Gulf of Carpentaria to go. We can also, on a blank globe or map that gives the network of lines, draw seas, continents and countries, and fix the positions of towns, if we are told their latitude and longitude.

In the open country or ocean, explorers and mariners find the latitude and longitude of a place by astronomical observations. There are several methods of doing this. One of the ways of finding latitude in the northern hemisphere is by observing how many degrees above the horizon is the North Star ; another way, used in either hemisphere, is noting the angle of the sun above the horizon at mid-day ; the elevation of either the North Star, or the sun at noon, gives the approximate latitude of the place from which the observation is made. Longitude may be determined by noting the time the sun crosses the meridian of the spot, then finding the equation of time and local noon, and comparing this with Greenwich time. These are however technical details resorted to by those in need of them.

THE ROTATION OF THE EARTH.—The earth rotates on its axis from west to east. This rotation has been proved by various experiments. An object dropped from a great height does not fall to the spot directly below, as would be the case if the earth were standing still, but a little to the east of it.¹ Again, when a pendulum is swung from a great height so that it passes over a fixed line marked on the earth beneath it, after a while it will be found that the pendulum has deviated from its original path.²

The earth's rotation causes our day and night, and we divide each period of rotation into 24 hours. To us it seems that the sun rises in the east at dawn, travels across the sky during the day, and sets in the west at nightfall. In reality it is the earth

¹ For the outer parts of a rotating body move faster than points nearer the centre of it.

² There is a practical demonstration of the pendulum experiment in the South Kensington Science Museum, London.

that moves.¹ If a round object (representing the earth) is held before a light so that half of it is lit and the other half in darkness, and turned from west to east, each part on its surface will pass from "daylight" to "night" and on to "daylight" again. The same thing happens to the rotating earth. An observer, if he could imagine himself on the Pole Star looking at the North Pole on our planet, would see half the earth in sunlight and the other half in darkness (diagram on p. 24), midnight at one place and noon at the point opposite, dawn at another spot and evening at its opposite point, and as the earth rotated each place in turn pass from midnight to morning, noon, evening and midnight again. The observer would also see that if at one place it were morning of Monday, at the spot opposite it would be evening of Sunday ; that is there are always two days in progress over the world.

As the earth rotates once in 24 hours, and its circumference is divided into 360 degrees of longitude (180° E. + 180° W.), there is a difference in time of four minutes for every degree of longitude, or one hour for every fifteen degrees. Looked at from the traveller's standpoint, every mile he travels due east or due west causes a difference in the local time. For instance, if he leaves Singapore (Long. 105° E.) at noon on Monday and travels westwards, after the earth has rotated once it will be Tuesday noon at Singapore, but if he is 1,000 miles west of Singapore (that is at Long. 90° E.), although 24 hours have passed it will be only Tuesday 11 a.m. at the place he has reached ; if he is flying and has gone 6,000 miles, and is now at Long. 15° E. in French Equatorial Africa, it will be Tuesday dawn there. After a second 24 hours have passed it is Wednesday noon at Singapore, while if our traveller has covered a second 6,000 miles, it will be Tuesday midnight to him as he crosses Ecuador in South America at

¹ The same illusion is experienced by people in a smoothly running train when passing a stationary train about twenty yards away ; the passengers obtain the impression that only the other train is moving. Again, when one of two stationary trains standing alongside of each other starts moving, passengers in it think the other is going.

Long. 75° W. After another 24 hours it is Thursday noon at Singapore, but Wednesday sunset for him as he nears the Phoenix Islands in mid-Pacific at Long. 165° W. One more day and it is Friday noon in Singapore, but when our airman finishes his last 6,000 miles and alights in Singapore he will say that for him it is only Thursday noon. Exactly the opposite happens when journeying eastwards ; then for every fifteen degrees of longitude covered the time will be one hour later than at the starting point ; that is if the traveller had gone in this direction, on reaching Singapore he would have said for him it was Saturday noon. This difference in the day was experienced by Ferdinand Magellan's sailors, who were the first people to sail round the world :

“ In order to see whether we had kept an exact account of the days, we charged those who went ashore to ask what day of the week it was, and they were told by the Portuguese inhabitants of the island that it was Thursday, which was a great cause of wondering to us, since with us it was only Wednesday. We could not persuade ourselves that we were mistaken ; and I was more surprised than the others, since having always been in good health, I had every day, without intermission, written down the day that was current. But we were afterwards advised that there was no error on our part, since as we had always sailed towards the west, following the course of the sun, and had returned to the same place, we must have gained 24 hours, as is clear to anyone who reflects upon it.”

ANTONIO PIGAFETTA

To avoid confusion, the world has been divided into time belts, and an International Date Line fixed at the 180th meridian of longitude, in the Pacific Ocean, where by universal agreement the new day begins.¹ Thus if it is Monday 2 a.m. in Alaska, it is Monday 5 a.m. in San Francisco, Monday 9 a.m. in Halifax, Monday 1 p.m. in London, Monday 7 p.m. in Calcutta, and

¹ The International Date Line runs for convenience entirely through water, and thus deviates in certain parts from the 180th meridian. This is in order that the tip of Siberia may have the same day as the rest of the country, the Aleutian Islands the same day as Alaska, the Fiji and Chatham Islands the same day as Australia.

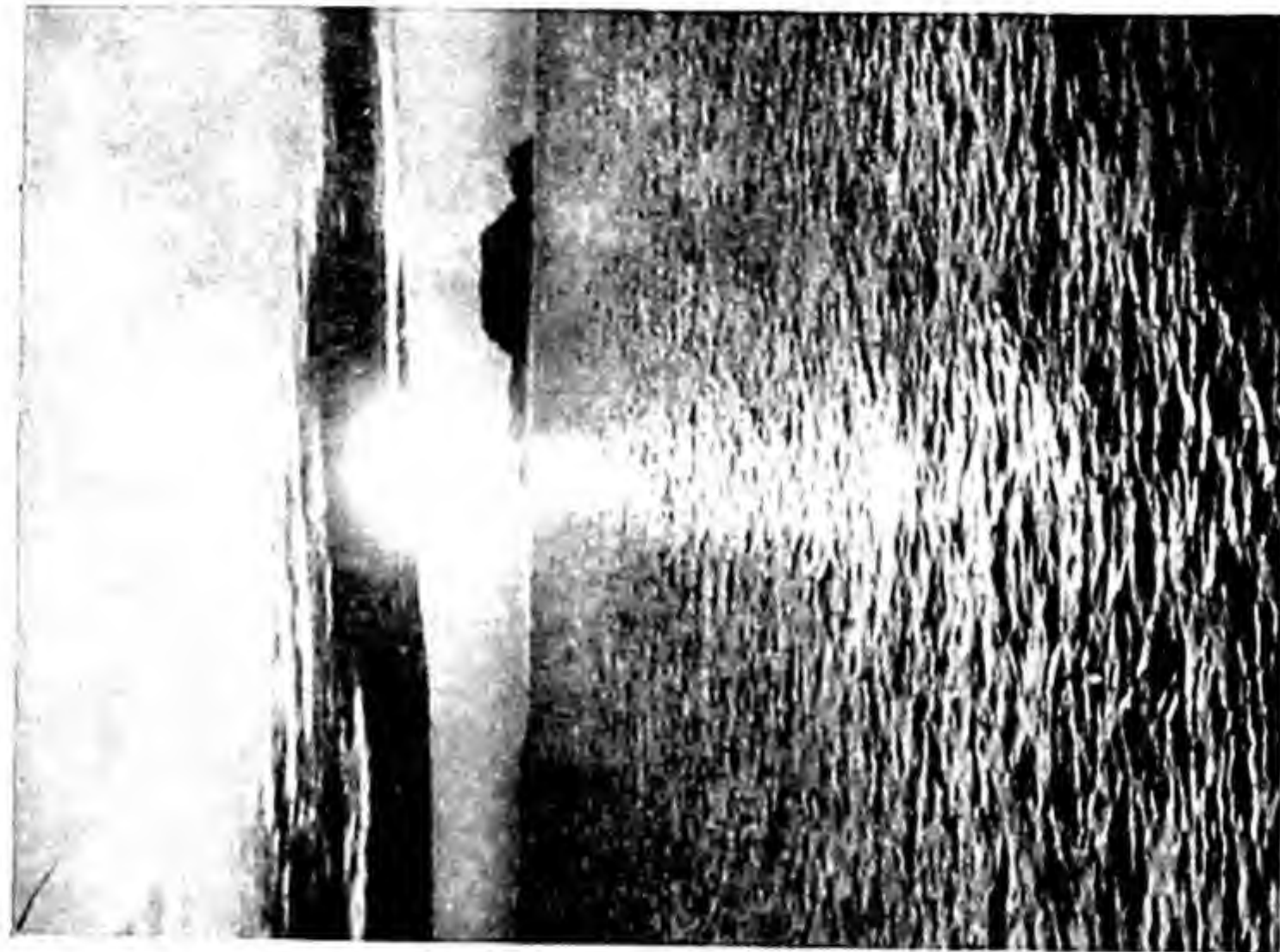
Tuesday has just begun in New Zealand and eastern Siberia. The time belts ensure that areas of certain sizes covered by a limited number of meridians keep uniform time, instead of each spot in those areas having its own time. For example, everywhere in Britain adheres to Greenwich time, the clocks in Eire are set 25 minutes earlier, and throughout Egypt they are two hours later than those of Greenwich. Travellers in ships sailing westwards or eastwards are advised every 1,000 or 2,000 miles to put their watches one or two hours backwards or forwards according to the direction in which they are going, so that when they arrive at their destination their watches agree with the time of the country. Those who go on world tours find that they have altered their time by 24 hours. This is noticed most at the Date Line, where a day is "lost" if travelling westward, or a day "gained" if journeying eastward.

"On Wednesday we crossed the International Date Line. To go to bed on Wednesday night, and wake up after a normal sleep of eight hours, to find that it is Friday morning, is somewhat puzzling at first sight, but is precisely what happens to everybody when crossing the Pacific Ocean in a westward direction."

C. W. COLLINSON

THE REVOLUTION OF THE EARTH.—Our rotating earth revolves round the sun, and the period of each complete revolution, during which it rotates $366\frac{1}{4}$ times, determines the year.

Every year most parts of the earth experience periodically hot, warm, cool and cold seasons, long and short days, and correspondingly the sun is seen higher and lower above the horizon at noon. These variations are due to the permanent tilt of the polar axis, which is not at right angles to the earth's orbit but inclined at an angle of $23\frac{1}{2}$ degrees from the vertical. This causes different parts of the world to be inclined alternately towards and away from the sun as the earth travels round it. If the earth were to revolve with its axis in a perpendicular position, we would not have different seasons nor any of the changes connected with them.



Courtesy of the Norwegian State Railways

THE MIDNIGHT SUN (page 12)



Courtesy of Mount Wilson Observatory

SOLAR PROMINENCE 80,000 MILES HIGH DURING
AN ECLIPSE (page 48)

The earth yearly does the same journey round the sun. Accordingly by examining the conditions in various places over the world at certain dates during a single revolution, that is for a period of one year, we learn what happens everywhere every year as a result of the tilt of the polar axis.

March 21.—On this day the position of the earth in its orbit is such that the polar axis lies parallel with the sun. To a person at the equator the sun appears to rise exactly in the east, to mount the sky until at noon it is directly overhead (*i.e.*, in the zenith), and to set due west. At both the North and South Poles the tip of the sun's edge is seen to circle right round the horizon, without rising or setting during the 24 hours. Everywhere in the world except at the poles day and night are of equal length (12 hours each), and this day is known as the equinox (equal night); it is the spring equinox of the Northern and the autumn equinox of the Southern Hemisphere.

March 21 to June 21.—During these three months, as the earth continues its circuit, the tilt of the axis causes the northern half of the world (the Northern Hemisphere) gradually to lean more and more towards, and the southern half (the Southern Hemisphere) to lean away from, the sun, until on June 21 the maximum inclination of $23\frac{1}{2}$ degrees is felt. This affects various parts of the world in the following ways :

From March 21 onwards the sun is seen overhead at noon farther and farther north of the equator till on June 21 it appears in the zenith at Latitude $23\frac{1}{2}^{\circ}$ North. This latitude is called the Tropic of Cancer, and marks the northernmost part of the earth's surface where at some time or another in the year the sun shines directly overhead at mid-day.

A person at the North Pole who on March 21 saw the edge of the sun circle round the horizon for 24 hours, sees it from day to day slowly rise higher and, without setting, circle round the sky continuously until on June 21 it reaches a maximum height of $23\frac{1}{2}$ degrees above the horizon (at the pole the sun is never seen higher than this in the sky). At the same time a slowly widening region round the North Pole also experiences continuous sun-

light and on June 21, when the inclination of the Northern Hemisphere towards the sun is most markedly felt, an area within a radius of $23\frac{1}{2}$ degrees latitude from the pole has sunshine for 24 hours. This region, the "land of the midnight sun", lies north of Lat. $66\frac{1}{2}^{\circ}$ N., which is known as the Arctic Circle.

While on March 21 the rim of the sun on the horizon at the North Pole heralded months of continuous sunshine (because the North Pole gradually leant towards the sun), at the South Pole it marked the beginning of the long dark period (because the South Pole started to lean away from the sun). After March 21 the sun is not seen either at the South Pole or in an area encircling it which gradually increases in extent until, on June 21, the district within a radius of $23\frac{1}{2}$ degrees latitude from the pole has continuous darkness for 24 hours. This region lies south of Lat. $66\frac{1}{2}^{\circ}$ S., which is known as the Antarctic Circle.¹

As during this period the northern hemisphere leans more and more towards the sun, so all places in this half of the world receive daily slowly increasing amounts of sunlight, and see the sun at noon ever higher in the sky.² At the same time, as the southern hemisphere inclines away from the sun, everywhere in that half of the world receives daily less and less sunlight and sees the sun lower in the sky at noon. With every mile farther north or south of the equator the days are longer or shorter until at the poles there is, in the north, continuous day, and in the south, continuous night; and the difference increases after March 21 until the inclination of either hemisphere is at its maximum on June 21, which therefore is the longest day in the northern and the shortest day in the southern hemisphere. The earth's position on June 21, the end of this period, is known as the solstice; it is

¹ The areas in the Arctic and Antarctic Circles are also called the polar regions or frigid zones. Outside these frigid zones every part of the earth has "day" and "night" every 24 hours throughout the year, though the duration of the periods of sunlight and darkness varies according to distance from the equator and the time of the year.

² The sun appears $23\frac{1}{2}$ degrees higher above the horizon on June 21 than on March 21 in all places north of the Tropic of Cancer.

the summer solstice of the northern and the winter solstice of the southern hemisphere.

June 21 to September 23.—In these three months some of the happenings of the previous period are reversed.

From June 21 onwards the sun is seen overhead each day farther south of the Tropic of Cancer until on September 23 it is in the zenith at the equator again.

At the North Pole the sun appears to circle lower and lower in the sky and at last, after six months of continuous sunshine, only the sun's rim is visible above the horizon. At the South Pole six months' continuous darkness ends on September 23 when the tip of the sun is seen again.

Days shorten in the northern and lengthen in the southern hemisphere as the tilting polar axis gradually returns to a position parallel with the sun.

On September 23 the conditions of March 21 are repeated throughout the world. Although at the equator days and nights are of equal length at all times of the year, it is only on these two dates that the whole world except the poles enjoys daylight for 12 hours and darkness for 12 hours. The position of the earth on September 23 is the autumn equinox of the northern and spring equinox of the southern hemisphere.

September 23 to December 21.—Conditions in these three months are the opposite of those that occurred from March 21 to June 21. The northern half of the world inclines away from, and the southern half towards, the sun.

After September 23 the sun appears daily in the zenith at noon farther south of the equator until on December 21 at mid-day it is seen directly overhead at Lat. $23\frac{1}{2}^{\circ}$ S. (the Tropic of Capricorn). South of this point the sun is not seen in the zenith.¹

During this period a gradually increasing area surrounding the North Pole has continuous darkness, and a proportionate

¹ Just as it is not seen in the zenith at any place north of the Tropic of Cancer. The area between the Tropics of Cancer and Capricorn, where at some place or another the sun appears directly overhead at noon, is called the *Tropics*.

area at the South Pole has continuous daylight. At the same time days slowly become shorter in the northern hemisphere and longer in the southern hemisphere.

On December 21 the conditions are the reverse of June 21. It is the winter solstice of the northern and the summer solstice of the southern hemisphere.

December 21 to March 21.—Everything that happened in the northern hemisphere from June 21 to September 23 now takes place in the southern hemisphere, and everything that then occurred in the southern half of the world now prevails in the northern half. After December 21 the sun daily appears at noon farther north of the Tropic of Capricorn until it is seen in the zenith at the equator at mid-day on March 21.

The seasons in the two hemispheres are *always* the opposite of each other. For instance, January means sunshine and hot weather to Australians, but to Britons it is the bleakest and coldest month in the year ; similarly July suggests opposite weathers to the two nations. If a person yearly were to live in the northern hemisphere from March 21 to September 23, and in the southern hemisphere from September 23 to March 21, he would always have mild or hot weather and never see a winter ; alternatively, if he were to dislike hot weather, he would simply reverse the dates of his sojourn in the two places, and thus enjoy continuous cold weather.

The Earth's Elliptical Orbit.—Although we speak of the earth "circling" or going "round" the sun, its course or orbit in reality is not a circle but an ellipse. At certain points in its course the earth is nearer to the sun than at others. In September and March it is 93 million miles away from the sun, in January $91\frac{1}{2}$ million, and in June $94\frac{1}{2}$ million miles. On account of this, in the northern hemisphere winter is slightly less severe, and summer a little more moderate, than in the southern hemisphere.

Eye-Witness Accounts.—Here are some accounts of the effects of the earth's revolution and tilting polar axis. A traveller describes what he saw when approaching the equator :

"As you drop down from latitude 40 to latitude 20 there is

a marked change. The water is bluer, the sky higher, and the upper zenith is filled with clouds that drift in curls and wisps and wings not usually seen at the north. Dropping down 10 degrees farther toward the equator you find the sun at noon so nearly overhead that you can hardly see your own shadow. At 6 o'clock the sun goes down straight into the west, or a little north or south of west dependent upon the season of the year. Moreover, it goes down and goes out speedily though often there is an after-glow in the upper sky."

JOHN C. VAN DYKE

The following are descriptions of experiences in the polar regions:

"The weather was getting hotter with 23 hours of sunshine—the Arctic Midnight Sun. It seemed impossible to go to bed in sunshine at 11 p.m."

NEVILL A. D. ARMSTRONG

"The longest summer's day here is of a great length, without any dark night, so that in July all the night long we might perfectly and easily write and read whatever pleases us."

SIR MARTIN FROBISHER

"The day had still been long in October, but in December it shrank to some three to four hours, and by the end of the month was reduced to a menacing short hour and a half of twilight."

ALEXANDER MORONOV

"The going down of the sun isn't the sudden spectacular event that so many people seem to imagine; there's no abrupt walling off between night and day. It is just a gradual, lingering passing of one, and a slow washing in of the other, like the ebb and flow of an infinite tide. Days after the sun set for the last time a great twilight expanded at noon, diminishing a little bit each day until there was just a watery crimson smear at noon on the horizon. But even at midwinter day that stain, overlaid with a faint yellowish glow, still persisted on the horizon."

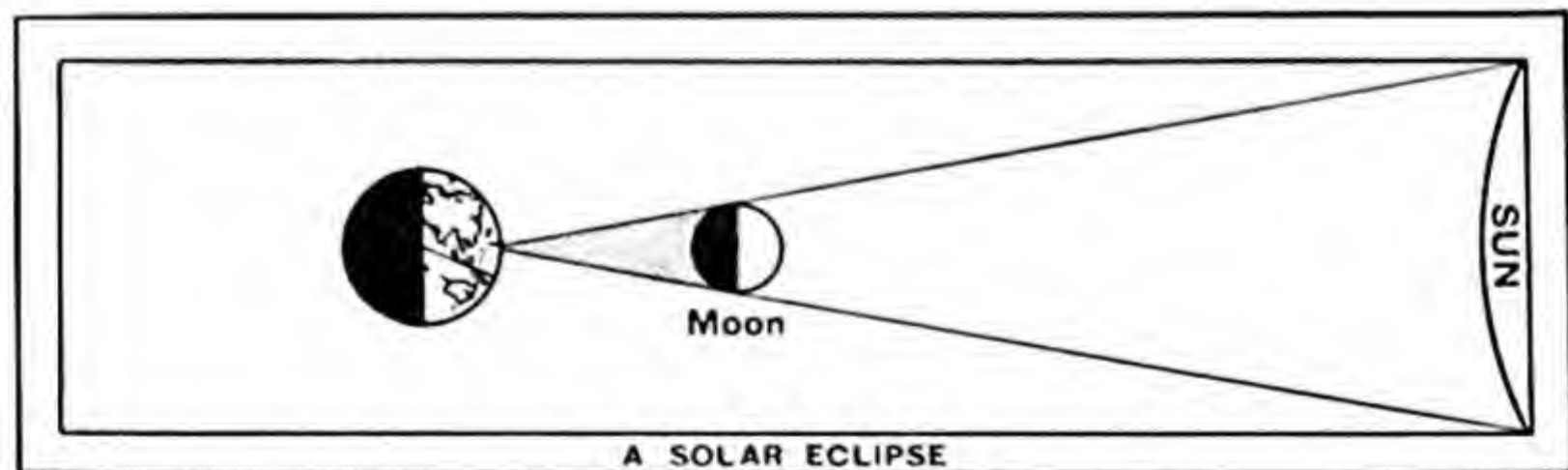
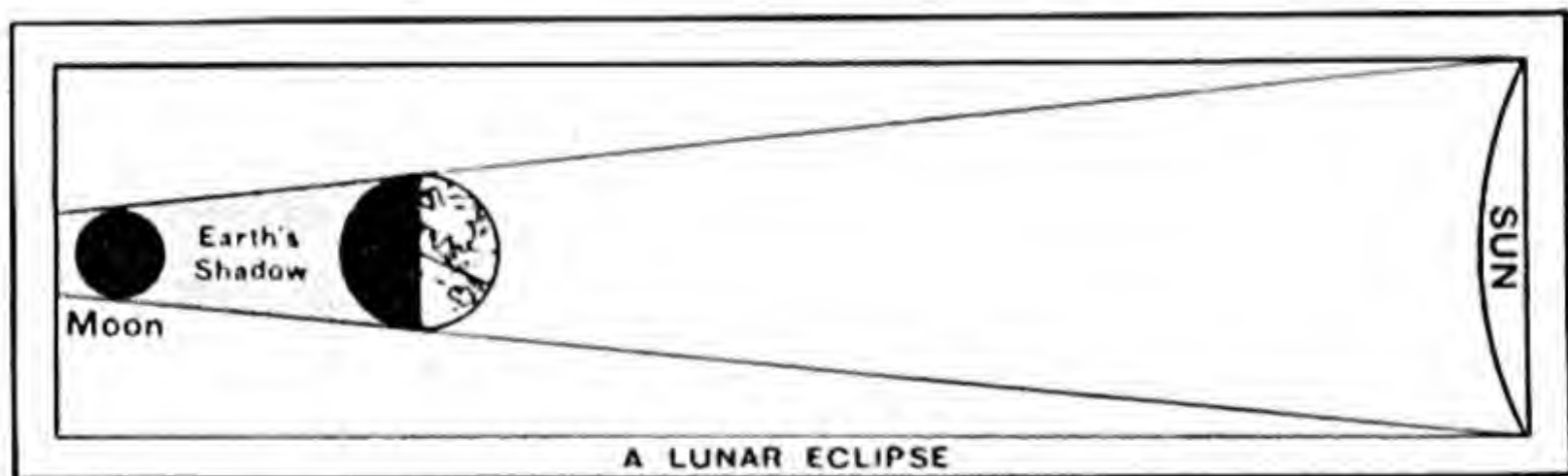
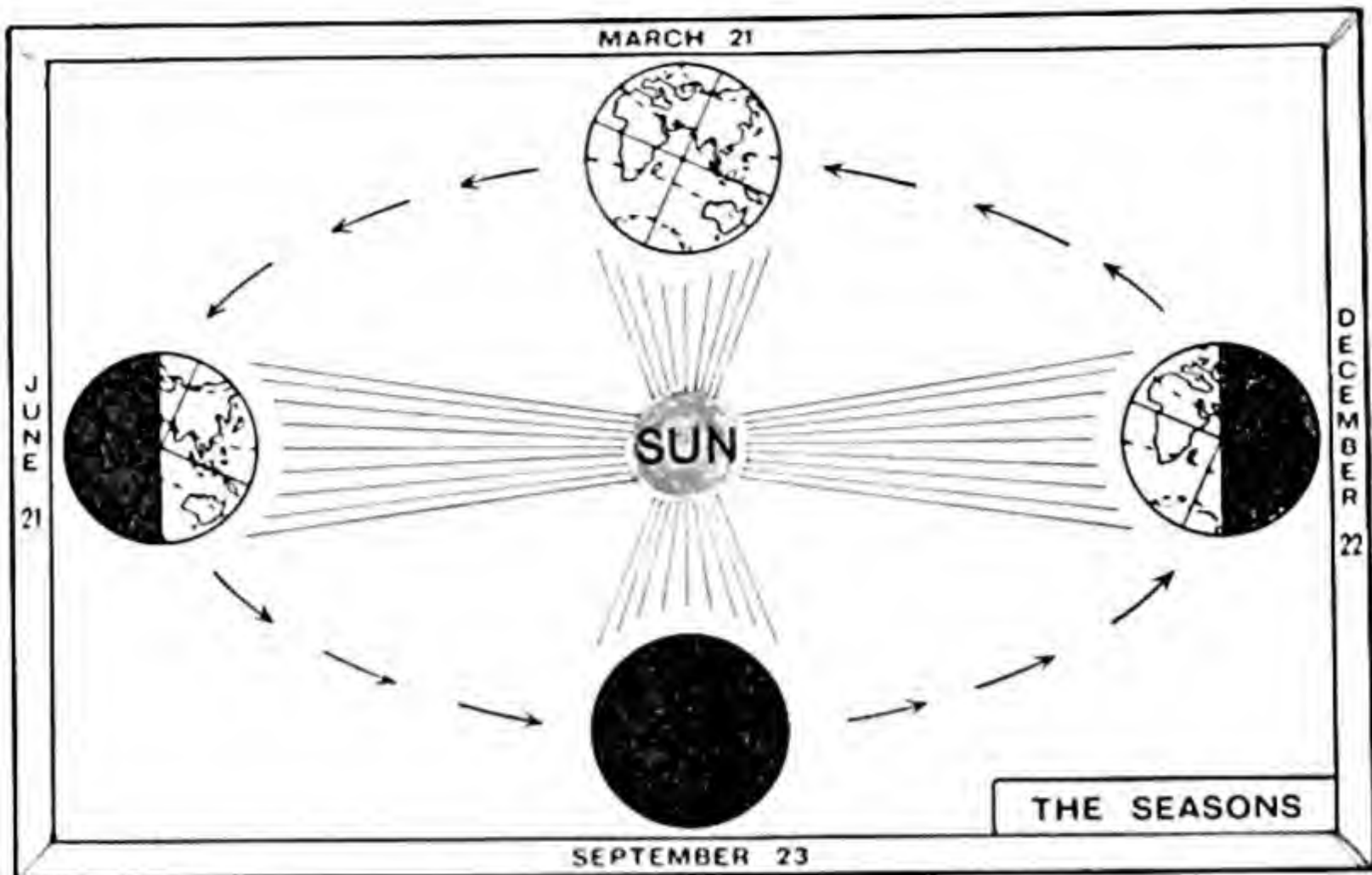
R. E. BYRD

"The upper edge of the sun appeared above the horizon to-day, after an absence of 89 days; it was a gladdening sight."

F. L. M'LINTOCK

"The return of the sun in polar regions is a very real and important event. It changes the outlook on life of every individual, for foul weather is robbed of its terrors."

R. F. SCOTT



ECLIPSES.—As the moon circles round the earth, and the earth (with the circling moon) revolves round the sun, sometimes the earth passes exactly between the sun and the moon, and prevents direct sunlight from reaching the moon and being reflected to us, so that we cannot see the moon shining during the short period it passes through the earth's shadow. This is called a lunar eclipse. At such times the moon can be seen glowing a dull reddish colour because of the indirect (refracted) sunlight it receives through the earth's atmosphere.

Sometimes the moon passes between the sun and the earth, and blots out from our sight a part or all of the sun, thus causing a solar eclipse. A solar eclipse can be of three kinds : partial, when an edge of the moon comes between us and the sun and we cannot see an arc of the sun ; annular, when the moon passes in front of the sun and covers all but an outer ring of it ; and most impressive of all a total eclipse. As the moon is much smaller than the sun, a total eclipse is visible only for a few minutes from a small area on the earth, usually a band of about 100 miles wide. The moon's path does not cross that of the earth horizontally but is inclined at an angle to it, and this is the reason why we do not have monthly eclipses every time the moon goes round the earth. Solar eclipses of some kind, however, occur several times a year, but a total eclipse takes place only about once every 18 months. Here is a description of a recent solar eclipse :

"I noticed the beginning of the partial eclipse. This phase lasted for about an hour, the sun appearing at first as if someone had bitten a piece out of it. This piece was getting bigger and bigger, while the sun assumed the shape of a crescent that was getting smaller and smaller. The temperature now began to drop. 'Totality' had begun. Through my field glasses I caught a glimpse of 'Bailey's Beads'. The moon's surface is not uniform ; it has valleys and mountains. Thus when the moon's disc is just inside that of the sun, the combined arcs are not exactly coincident. There are glittering little ringlets lit up by the covered sun. These are the famous 'Beads'. As the circle of the moon became concentric with that of the sun, the corona

shone in all its glory. The brilliant ring and its wonderful streamers provided a spectacle I shall never forget. Suddenly, there came a complete change. The bright lines of the coronal spectrum turned dark. We had reached the 'third contact' and the sun was emerging again. During the comparative darkness of the 'total eclipse' it was possible to see Mercury, Venus and Mars in the neighbourhood of the sun."

SIDNEY I. LUCK

GLOBES AND MAPS.—As the earth is spherical in shape, the most satisfactory model of it is a globe. But globes would have to be made very large to show many details, and they are too unwieldy for use by airmen, motorists, sailors and travellers. For these reasons we use maps, which represent on a flat surface the features of areas at reduced scales. We can have maps of any size and show on them as many details as we desire, and also fold the maps or have them in a book.

But maps, especially those of the world, have their particular drawbacks. If we made a globe of thin paper and attempted to open this out flat on a table like a map, we would find that in flattening out the paper it would be torn and leave spaces between the separated edges; if we now tried to patch up these torn places by putting other slips of paper to fill the gaps, we would discover that in these places we have enlarged the countries or seas and made them out of proportion to the areas that were not torn. This is the problem that has faced map-makers, and they have produced different kinds of maps.

One of these is Mercator's Projection, in which the lines of longitude are not drawn converging at the poles as shown on a globe, and so the areas are distorted, North America appearing very much bigger than South America, and Greenland almost as large as Africa. Another map is Mollweide's Projection, where the lines of longitude meet at the poles, but they are drawn much too curved towards the edge of the map, and so not the areas but the shapes of countries are distorted, for example Alaska is made to look small and squat, and New Zealand has an attenuated appearance. Yet another map, the best so

far made, is Goode's Homolosine Projection ; this shows tears, such as we obtained when flattening out the paper globe, but the tears are few and placed in the oceans, and thus both the shapes and areas of the continents are drawn practically correct.¹

Maps that show only parts of the world are less difficult to make accurate. For instance, if we cut out only a section from our paper globe (the British Isles, India, Australia, or any other country), we would find that it would flatten out without tearing, and we can draw enlargements of it without altering the shape or area, and thus have more room on it for minor details. The smaller the area that is cut from the globe and enlarged the more accurate is the map.

With all maps an important point to remember is that what we see on paper is a representation of a large area within a small compass. This reduction in size is called the scale. The sizes of the maps alone are no guide to the extent of the areas presented, for in the self-same atlas on one page might be a map of the whole world, on another that of India, and on a third Switzerland, yet these places have by no means equal areas. It is by looking up the scale of each map that we obtain an idea of the actual size of the place ; on the map of the world 1 inch might represent 3,000 miles of the earth's surface, on the map of India 1 inch might equal 300 miles of that country, and on the third 1 inch might equal 24 miles of Switzerland. When consulting maps of countries in text-books and atlases, the scale of the map should always be noted, and reference made to the map of the world to realise the proportionate size of the country.

EXERCISES

1. Explain shortly the meaning of : the earth's inclined axis, barysphere, magma, fossil, glacial age, dinosaur, parallel of

¹ Examples of these and other maps are given in this book. Although in these examples the lines of longitude are omitted in order to show up other details clearly, a comparison between them will reveal distinctly their differences.

latitude, meridian of longitude, international date line, lunar eclipse, solar eclipse, scale of a map.

2. How can we prove the earth is round?
3. Give reasons for the belief that the continents drifted.
4. What causes day and night?
5. Rewrite, filling in the missing words :

The earth is — in shape. The — — always points to the North Star, and as the earth revolves round the —, the north pole and south pole sometimes — — and sometimes — — the sun. When the north pole inclines towards the sun, the northern hemisphere enjoys its —, and the southern hemisphere its —. When the north pole inclines away from the sun, it is — in the northern and — in the southern hemisphere. The earth takes a — to complete each revolution round the sun, and it also — once every — hours. Its rotation causes parts of the world alternately to receive — and be in —, hence our — and —.

COMPOSITION

Give your views on : "Time would not pass if the earth and universe were stationary."

LOCAL STUDY

Find from a map the approximate latitude and longitude of your home. Keep an account of the apparent height of the sun at noon (summer and winter) above the horizon.

HANDWORK

Draw a sketch map of your neighbourhood to show the shortest route from your home to the school.

Drawings of any fossils, etc., seen in a museum.

GAME

One person gives the latitude and longitude of a number of towns, and the others find out and write down the name of the town, the country and continent in which it is situated, whether it is an inland city or a seaport, and the nearest river.

CHAPTER THREE



Crosen Copyright. Courtesy of the Geological Survey and Museum
 SEDIMENTARY ROCKS (page 46)



Crosen Copyright. Courtesy of the Geological Survey and Museum
 THE FORMATION OF COAL (page 57)

CHAPTER THREE

LAND : ITS COMPOSITION

ROCKS.—The earth's crust, the land on which we live, is known as the lithosphere. It is composed of rocks, which are of many kinds and of varying textures and colours. A walk in the country, by the sea, or among the buildings of a town, furnishes specimens of some of them. Sandstone is usually reddish in colour, coarse-grained and rough to the touch ; limestone and chalk are white, inclined to crumble and slippery to walk on ; granite is grey, firm, and contains specks that glitter in the light ; basalt is black and extremely hard ; marble is very smooth and either white or delicately tinted ; slate is blue-grey in colour, and though hard, splinters easily. Observant travellers notice that the scenery of a region is due largely to its rocks.

“ I think there is somewhat peculiarly sweet and amusing in the shapely figured aspect of chalk hills in preference to those of stone, which are rugged, broken, abrupt and shapeless.”

GILBERT WHITE

Rocks are classified, according to their origin, into three groups : sedimentary, igneous and metamorphic.

Sedimentary Rocks, the commonest variety, cover the greater part of the earth's crust and extend in many places for depths of several miles. Sandstone, limestone, shale and coal belong to this class. They are formed by the accumulation of waste matter, and are therefore arranged in layers or strata, which makes them easily recognisable.¹ One layer of waste settles and is covered by another, then by another and another, until in the course of time, through pressure and the action of rain or water, the particles are welded together and form a rock mass. Usually the

¹ The layers may be tilted, folded, etc., by earth movements.

waste stuff (sand, mud, silt, pebbles, bits of rock, the remains of plants and animals, etc.) is deposited in a swamp, a lake or shallow sea, being carried there by streams and rivers. Sometimes it accumulates on land and is added to by waste blown there by the wind, or left by streams that overflow their banks during times of flood. Sedimentary rocks are inclined to be soft and porous, unless like coal they have been buried deep and subjected to great pressure.

Limestone is a sedimentary rock of special interest. It is composed of the remains of the shells and skeletons of sea creatures, and has usually been formed under clear sea water.

"What struck me about Cetinje¹ was the extraordinary whiteness and cleanliness of everything. It was partly due to the wonderful clarity of the air and partly to the light colour of the limestone, both in the rocks and mountains and in the houses and cottages which are built of it. The streets and roads themselves seemed white also."

PAUL EDMONDS

"It is a frightful stretch of country.² The rock is honey-combed and stands on end; it forms fissures and craters, and every step has to be watched, for the limestone edges are as sharp as broken glass. There are no running streams, no water, for the rain seeps immediately through the limestone. A stunted and tangled growth covers it all, with the geru palm predominating. The reader has probably seen limestone caves somewhere, and if he can visualise a mountain barrier of such formation rising in places to 8 or 9,000 feet, he will arrive at some idea of what this terrible country is like."

J. C. HIDES

Igneous Rocks are those which have solidified from a molten state. Some, like lava, have come forth from volcanoes or through fissures in the earth's crust. Others, like granite, appear when their covering layers of sedimentary rocks have worn down. Igneous rocks are always extremely hard and impervious.

Metamorphic Rocks, as their name suggests, are rocks that have

¹ A town in Montenegro, Jugoslavia.

² A section of the island of New Guinea, north of Australia.

undergone some kind of transformation from their original state. They are sedimentary and igneous rocks which, owing to earth movements, have been buried very deep and altered by the action of heat and pressure. Limestone changes into the metamorphic rock marble, clay into slate, etc.

SOIL.—Soil is finely-ground rock usually containing decomposed plant matter. Soils may be a few inches or many feet deep, and vary according to the kinds of rocks from which they are derived. Often they consist of a mixture of different types of rocks, for in addition to being formed on the spot by the breaking up of local rock (see p. 99), they are sometimes carried there by rivers and glaciers or by the wind.

The consistency of all soils is not the same. Sandy soils (usually reddish or yellow in colour) are loose and therefore light to handle, but as water drains through them rapidly, they are apt to be dry. Clay soils (reddish-brown) are heavy, hard to dig, hold any water they receive, and become water-logged if the rainfall is heavy. Loam (black), a mixture of sand and clay containing much vegetable mould, is extremely fertile. Peaty soil (black) is difficult to cultivate because it contains much moisture and undecomposed vegetable matter. Volcanic soils (black), caused by the decay of lava, are very productive. Loess (yellow), the name given to wind-borne soil, consists of sand and clay mixed. In the last century geologists puzzled for many years over the way loess was formed, but now it is no longer a subject for speculation.

“Sandstorms raging through the centuries are supposed to have made the loess formation which is so characteristic of Chinese Turkistan, and so amenable to the spade of the cultivator, when irrigated. The countless layers of compressed sand are capable of producing splendid crops. The loess is also most useful in another way ; for, when mixed with chaff and water, it forms the staple building material.” ELLA AND SIR PERCY SYKES

The type of soil in a district helps to determine the kind of crops that can be grown there.



Courtesy of the Geological Survey and Museum
 A TYPICAL CHINA CLAY QUARRY (page 57)



Courtesy of the Imperial Institute
 IN A CANADIAN NICKEL MINE (page 61)

MAN'S USE OF LAND

The earth's crust not only provides man with a place on which to live, and with soil in which to cultivate his crops, but also with many of the necessities of life.

THE ROCKS.—Such rocks as sandstone, limestone, granite, marble and slate are quarried for building material ; limestone and clay are made into cement ; different kinds of clays are used for brick, tile, porcelain and china making ; sand and gravel for road making and the manufacture of concrete ; and sand for glass making.

THE MINERAL FUELS.—Two of the most valuable commodities obtained from the rocks are the mineral fuels coal and petroleum.

Coal is important both as a fuel and for the substances manufactured from it : gas, ammonia, benzol, and especially coal-tar from which are derived drugs, dyes, perfumes and explosives. Coal consists of petrified vegetation and is therefore, as we have seen, a sedimentary rock. It varies in type according to the depth and length of time it has been buried, and the amount of heat and pressure to which it has been subjected. There are four main kinds : peat, lignite, bituminous coal and anthracite.

Peat is vegetable matter in the first stage of its transformation into coal. It consists of a mass of tightly-packed decayed plant-roots and fibres. It is cut from bogs and swamps, and after drying, used locally for domestic fires in such countries as Eire, north Germany, northern Denmark, Lithuania and Russia.

Lignite or brown coal is vegetable matter in an advanced stage of development into high grade coal. It is fairly hard and obtained from mines, but when burnt leaves much ash—four tons of it are needed to give as much heat and power as one ton of bituminous coal. But it can be used for the manufacture of gas, coal-tar, ammonia, benzol, pitch and briquettes. Great use is made of the large lignite deposits in Germany.

Bituminous coal is the ordinary good coal used for ships,

engines, ironsmelting, manufacturing and domestic purposes. Much of the coal used in homes is bituminous coal. There are of course various grades of it, some better than others. Nearly every country in the world contains some coal; the greatest producers are Great Britain, Germany, the United States and Russia.¹

Anthracite is the hardest kind of coal; it burns with very little smoke, gives intense heat, and leaves little ash. It is used in blast furnaces, liners, and for such domestic purposes as central heating. It is mined in South Wales, the Western United States and Russia.

Petroleum or mineral oil is of great importance as a fuel because it can be transported easily, burns almost without smoke, and leaves no waste; from it are produced petrol, paraffin, benzine, kerosene, vaseline, etc. It is believed to be derived from the remains of tiny one-celled plants or animals which, millions of years ago, were covered by layers of rocks and have since decomposed into thick liquid. The chief petroleum-producing countries are the United States, the U.S.S.R., Venezuela, Rumania, Iran, the Dutch East Indies, Burma and Mexico.

Petroleum is also obtained from *oil shale*, that is rock which is impregnated with oil but contains no liquid that can be pumped off. There are deposits of oil shale in south-east Australia, the Baltic states, Russia and Scotland.

In many places *natural gas* is present with petroleum. Gas is used for lighting, heating and power.

Asphalt or pitch is found in some places near the oil-fields. It is not a fuel, but consists of petroleum mixed with and acted on by oxygen from the air. The asphalt lake of Trinidad is the most important in the world.

"This spot (the asphalt lake in Trinidad) has been described as one of the wonders of the world. The asphalt is hooked out in chunks with a pick. The lump so delved is lifted up with the hands and thrown ignominiously into a truck. These trucks run

¹ The countries mentioned here and subsequently in this chapter are arranged in order of their output.



Courtesy of the Imperial Institute

A BURMA OIL-FIELD (page 58)



Courtesy of the Imperial Institute

THE TRINIDAD PITCH LAKE (page 58)

on rails and sleepers across the lake. On each side of the truck-way a trough or trench is produced by the labours of the men with the picks. This trough rapidly fills again level and solid, is again dug out only to close in once more. It thus becomes about that although the asphalt is being removed at the rate of 100,000 tons a year, the lines of the rail need never to be altered in direction. The lake, like the Burning Bush, is not consumed."

SIR FREDERICK TREVES

"In the pools left by the rain the gas comes bubbling up with a queer humming sound, and in these pools are the pitch fish. They are tiny creatures, and when one pool dries up they wriggle their way at night, when the asphalt is moist with dew, into the next."

OWEN RUTTER

THE MINERALS.—All rocks and rock-waste contain mineral matter, though the majority have only very small amounts in them. The red colour of some sandstone and soils is due to the presence of small quantities of iron, the glitter of granite to specks of quartz, and so on.

When rock masses are disturbed by earth movements, gases and water-vapour escape from the magma into the earth's crust, bringing with them in solution other matter contained in the magma. The matter thus brought up later cools and crystallises among the rocks, forming veins of minerals, or mixes with the rocks and produces ores. These are the larger deposits of minerals generally used by man, which become available when the mountains get worn down, when the land is gashed by internal disturbances, or when they are carried by rivers and streams and deposited in their valleys.

There seems to be no definite rule as to which rocks contain minerals in sufficient quantities for commercial utilisation. Generally speaking, the mountains that were formed in the earliest earth movements and have since been much worn down are richer in minerals than those that came into being during later disturbances, though in some places the latter also contain vast deposits. However, so far, certain substances such as radium,

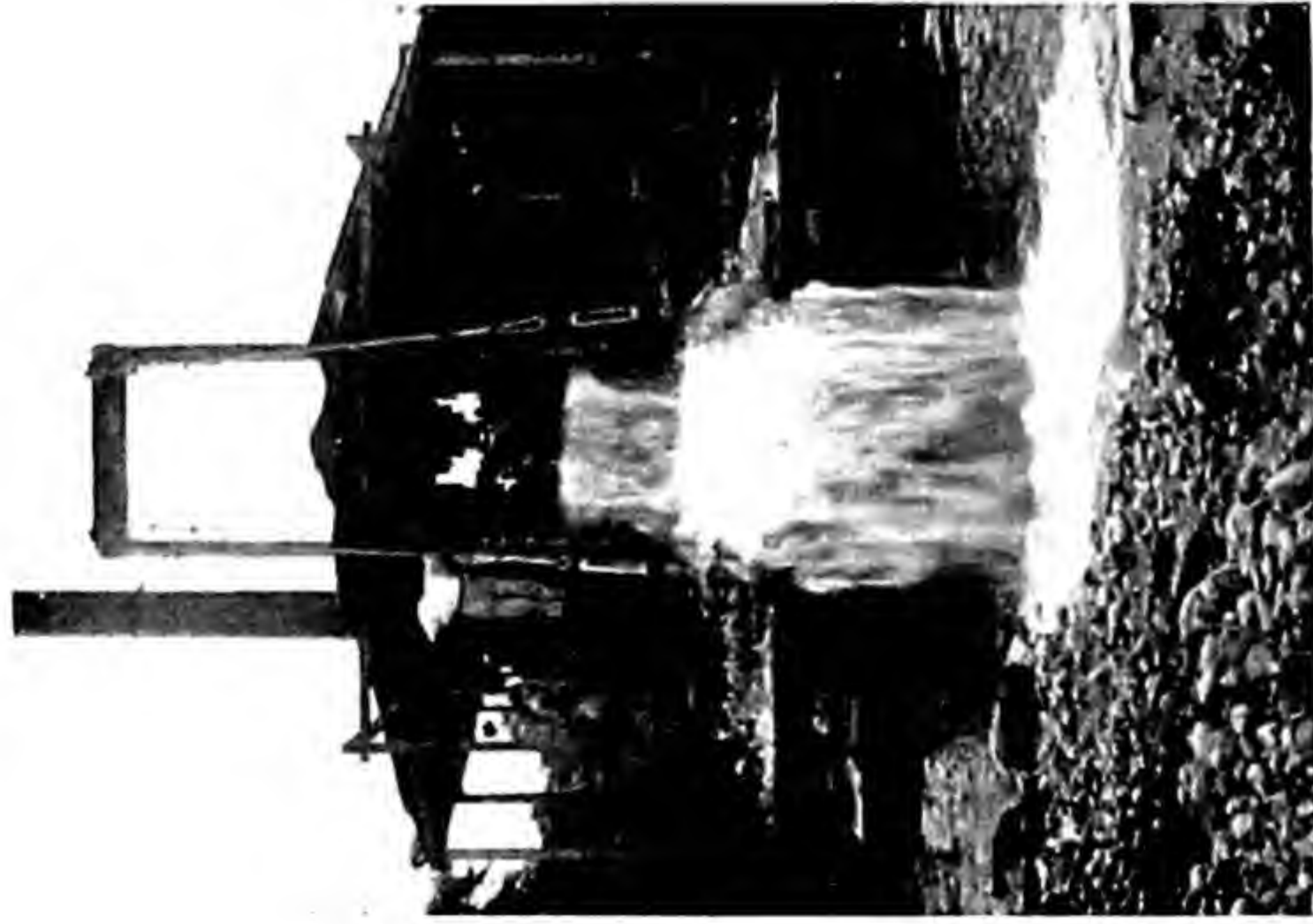
chromium, cobalt, asbestos and diamonds have not been discovered among the "newer" mountain ranges.

Metals

Iron (a hard blackish-grey metal) is one of the most abundant of minerals, and is mined in many countries. It is produced in large quantities by France, the United States, the U.S.S.R., Great Britain, Sweden, Luxemburg, Germany, and Spain. Iron is one of the most important minerals because it is needed for making all our machines, trains, ships, bridges, large buildings, and many of our domestic necessities from pins to bedsteads. It is found as an ore (*i.e.*, mixed with other substances), purified into pig-iron or cast-iron by smelting in furnaces, and then hardened into steel by mixing with it small amounts of other minerals such as manganese, chromium, tungsten, cobalt, nickel, vanadium and molybdenum, the hardening substance being chosen according to the type of steel required. As regards these substances used in the manufacture of steel, manganese is exported by India, Brazil and Spain, and is also used for paint-making and in the electrical industry ; chromium is mined in Yugoslavia, Russia, India and Rhodesia, and used for dyeing, tanning, and making paint and furniture ; tungsten or wolfram is obtained from Portugal, Bolivia, China and Burma, and used for chemical and electrical apparatus ; vanadium is mined in Peru ; cobalt is exported by Canada and used in the manufacture of paints and pottery, and this same country supplies practically the whole of the world's nickel.

Aluminium (white) is obtained from the ore bauxite, which is mined in France, Russia, Italy, the United States and the Guianas. It is used for making kitchen utensils, aeroplane and motor-car parts and electric appliances.

Antimony (white) is derived from various ores, deposits of which exist in France, Yugoslavia, Bolivia and China. It is used in medicine, for mixing with and hardening other metals, for vulcanising rubber, and for making pewter and paints. One



Courtesy of the Brazilian Consulate
GOLD WASHING (page 63)



Courtesy of the High Commissioner for Southern Rhodesia
ASBESTOS (page 64)

kind of antimony (antimonite) is used in eastern countries for darkening the eyelids.

Copper (reddish-yellow) is used for domestic appliances, electric wires, and for mixing with tin to make bronze and bell-metal, and with zinc and tin to make brass. The world's chief copper mines are in the United States, Canada, Chile, Rhodesia, the Belgian Congo, Japan, Mexico, Russia.

Lead (soft bluish-grey) is used for water and drainage pipes, for type metal, and with antimony and tin to make pewter. The world's main supplies of lead come from the United States, Australia, Mexico, Canada, India, Spain, Yugoslavia, Germany, Bolivia.

Mercury or quicksilver (a silvery liquid) is used for thermometers, the backs of mirrors, paint-making and in medicine. It is the liquefied vapour obtained from heating the ore cinnabar, which is found in Spain, Italy and Peru.

Tin (bright white) is obtained mainly from the ore cassiterite, large deposits of which exist in Malaya, the Dutch East Indies, Thai, Bolivia, the U.S.S.R., South Africa, India, Tasmania. It is used for making food containers, tin-plating (*i.e.*, coating iron with thin sheets of tin), and mixing with other metals to make bronze and pewter.

Zinc (greyish-white) is used with copper to make brass, in the manufacture of paints and wire, and for galvanising or coating iron. It is obtained from the United States, Canada, Mexico, Bolivia, Australia, India, the Belgian Congo, Germany, Yugoslavia, Italy, Spain, Sweden, Poland.

Precious Metals

Gold is used for jewellery and coins. It is found sometimes as veins in the rocks or as dust and nuggets among river gravels. The chief gold producers are South Africa, Canada, the U.S.S.R., the United States, Australia, Brazil.

Silver also is used for jewellery, coins and plate. It is usually found mixed with other metals, such as lead, copper and zinc.

It is mined in Mexico, the United States, Canada, Australia, Peru, India, China, the U.S.S.R.

Platinum (white), owing to its scarcity, is more expensive than gold, and is used for jewellery and in the chemical and electrical industries. It is found among river gravels and in grains among certain rocks in Colombia, the Ural Mountains of the U.S.S.R., and in the Transvaal.

Radium, the rarest and most expensive of minerals, is used in medicine for taking X-ray photographs and for curing certain diseases. It is obtained from uranium or pitchblende in the Belgian Congo, Russia and Canada.

Non-Metals

Asbestos is the name given to heat resisting silky fibres found among rocks in Canada, South Africa, Manchukuo and the U.S.S.R., and used for making such things as fire-proof clothing, curtains and cooking mats. The fibres are the crystals of substances formed from mixtures of iron, magnesium, silica, etc.

Emery (greyish) is a substance that is first powdered and then used for polishing. It is a mixture of aluminium and other substances, and is obtained from Greece and Turkey.

Graphite (black), mined in the United States, Germany, Ceylon and Chosen, consists of almost pure carbon, and is used for the lead of pencils, electro-plating and electric appliances.

Meerschaum (whitish), obtained from Turkey, is used for making pipe-bowls. It is a mixture of magnesium and silica.

Mica (of various colours) is used in the electric industry, for paint-making and as a lubricant. It is made up of mixtures of several substances (silica, aluminium, potassium, etc.), and the chief deposits are in India.

Sulphur (yellow) is used medicinally and for making sulphuric acid for the manufacture of matches, dyes, glass, and wood-pulp products. Most of the world's sulphur is supplied by Italy and the United States.

Salts of various kinds are found in many areas. They are the

whitish substance left behind when lakes or shallow seas dry up owing to the evaporation of their waters. Salts therefore are obtained from the beds of former salt lakes or the margins of present-day salt lakes. In the case of lakes or seas that dried up millions of years ago, their salts have been covered by layers of rock and soil and can now be obtained by mining. The two chief kinds of salts are common salt and the mineral fertilisers.

Common salt is an essential ingredient of our food, and is also used for preserving meat and fish, in the chemical industry and in the manufacture of glass and pottery. It is obtained from mines, salt lakes and coastal lagoons throughout the world.

The mineral fertilisers are used, as their name suggests, for increasing the fertility of the soil, but they are also of importance in the manufacture of various chemicals. The three main kinds are : nitrate of soda, obtained from the substance called caliche (which also contains iodine) found only in the Atacama Desert of Chile ; potash, mined in France, Germany, Russia and the United States ; phosphate, obtained from deposits in Russia, Florida, and some of the Pacific islands.

Precious Stones

Precious stones are the crystals of various substances.

Diamonds, the most expensive stones and the hardest substance known, are crystals of pure carbon. It may be interesting to remember that graphite also consists of carbon, so does soot and lamp black. The " best " diamonds, that is those " of the first water ", are colourless ; less costly stones may be yellow or red. Diamonds are obtained from South Africa, the Belgian Congo, Angola, Brazil and the Guianas.

Rubies (red), sapphires (blue), topaz (yellow), turquoise (greenish-blue), emeralds (green) and amethysts (purple) are simply crystals of certain compounds of the metal aluminium. Other kinds of emeralds and amethysts are the crystals of a variety of quartz (the substance that glitters in granite). Quartz crystals also form opals, which are milky in appearance and shine with

different hues when reflecting light. Rubies and sapphires are mined in Burma, Thai and French Indo-China, emeralds in Colombia, topaz and turquoise in Iran and the United States, and opals in Australia.

The so-called semi-precious stones are in reality merely pieces of coloured rock, cut and polished to show their beauty. Jade (green) is a mixture of calcium, magnesium and iron ; agate, onyx, jasper and cairngorm are different forms of quartz ; lapis lazuli, moonstones, garnets and aquamarines are varieties of silica ; jet (black) is a kind of lignite or brown coal.

Amber (golden) is in a class by itself. It is not a true mineral, for it is petrified resin, that is drops of sap from long dead pine trees that have been transformed into stone. It is collected on the seashores of North Germany and the Baltic states.

THE ELEMENTS.—Substances that cannot be decomposed are known as elements, and so far about 70 of these have been found and listed. All metallic minerals are elements, so are sulphur and pure graphite (carbon) among the non-metals, and so is diamond (carbon) among the precious stones. The mineral-fuels, the non-metals other than sulphur and pure graphite, and the precious stones other than diamonds are all mixtures of two or more elements. The earth's crust consists of elements in the following percentages : oxygen 50, silicon 25, aluminium 8, iron 5, calcium 3, potassium 2, sodium 2, magnesium 2, all others 3.

EXERCISES

1. Give a short account of the mineral fuels.
2. State how soil may be formed.
3. What are : lava, loess, peat, lignite, bauxite, wolfram, pewter, brass, bronze, radium, asbestos?
4. Describe briefly any six important minerals.
5. Rewrite, filling in the missing words :

The earth's crust consists of —. These are of — classes : — rocks, such as sandstone, formed by — of waste matter settling

and accumulating ; igneous rocks, such as —, due to molten matter — ; and metamorphic rocks, such as —, made from sedimentary and igneous rocks which have — their former state owing to being — — in the earth. Soil is merely — — —. The earth's crust provides man with a — in which to —, with — in which to grow his —, with rocks for — —, with — and the — — coal and petroleum, and with — —.

COMPOSITION

The story of a lump of coal, asphalt or chalk.

LOCAL STUDY

Make a list of all the different kinds of rocks and soils seen in your neighbourhood.

HANDWORK

Prepare a series of sketches and if possible collect specimens of the rocks in your neighbourhood.

Draw a map of the world to show the chief mining areas.

GAME

One person gives the name of a mineral mentioned in this chapter, and the others in turn state what they think are its colour and uses. The one who gives the most satisfactory answer provides the name of the next mineral.

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CHAPTER FOUR

LAND : ITS SURFACE

RELIEF.—The land surface of the world is irregular. In large areas uplifted rock masses form great mountain ranges, and these are cut by valleys and chasms. In some parts there is gently undulating country where rounded hills overlook wide dales ; in others, highlands flatten out their summits into spreading plateaus ; and elsewhere extensive lowlands a few feet above sea-level stretch flatly to the horizon. In a few places the surface is hollowed out into depressions and one can walk on dry land many feet below sea-level. Thus we have impressive contrasts : mountains and valleys, plateaus and plains, but compared with the size of the earth this relief is insignificant, for even five miles high mountains on the earth are proportionately less than the wrinkles on a withered apple. About $\frac{1}{3}$ of the earth's crust consists of mountains of 3,000 feet and more elevation ; $\frac{1}{2}$ of highlands varying in height from 600 to 3,000 feet ; and the remaining $\frac{1}{6}$ of lowlands lying less than 600 feet above sea-level.

On globes and maps, plains are sometimes shown coloured green, plateaus light brown, and mountains brown ; or different shades of the same colour are employed to suggest the various heights of the land, and occasionally the directions of the mountain ranges are also drawn. On maps of small areas, however, often hills and mountains are indicated by contour lines. In the latter case a line is drawn connecting all points of the same altitude, then a second line through points that have a higher altitude, then a third through points that are uniformly higher, and so on until the highest places in the district are thus shown ; according to the scale of the map, the lines may represent successive elevations of 10 or 20 or 30 or 100 or more feet.

MOUNTAINS

We call mountains those parts of the earth's crust that have heights of 3,000 or more feet above sea-level. Mountains do not often occur singly, but in groups and ranges. One range may stretch for hundreds of miles across the country, and may or may not divide into branches ; some ranges run parallel to each other ; others from different directions merge into one. These arrangements are due to the fact that the mountains were built up during periods of widespread earth movements. Often a mountain range runs down the coast in one country and disappears, to emerge on the other side of the sea in another country. This may be due to the shifting apart of the continents already mentioned (p. 32), or it may be that the mountains continue under the sea.

YOUNG FOLDED MOUNTAINS.—The greatest mountains of the world are the young folded or alpine mountains. They are called " alpine " because they were formed by the alpine earth movements of Tertiary times (about 30 million years ago), " young " because these movements are the most recent of the series of three known to have occurred, and " folded " because the earth's crust was subjected to such stress and pressure that it buckled up into folds, as a thick tablecloth on a table will do if it is pushed firmly from one or two directions.

These alpine mountains are in two main groups. One extends from east to west across Central Asia and Southern Europe, the other runs from north to south along the western coasts of the American continents.

Asian and European Young Folded Mountains.—This group is a complex system of ranges covering great stretches of land. Although the ranges of the two continents are connected, for convenience we will consider them separately.

The centre of the Asian section of the system is the Pamir Plateau, situated in the heart of the continent where the boundaries of India, Afghanistan, the U.S.S.R. and Sinkiang meet. From

the Pamirs several mountain chains radiate out like the spokes of a wheel : the Himalaya, Kun Lun and Tien-Shan going to the east ; the Hindu Kush and Sulaiman ranges to the west.

In eastern Asia the Himalaya merge into the tangled highlands that pass south into Burma and Indo-China ; possibly the mountains of the East Indies and of eastern Australia and New Zealand are a continuation of these same ranges. The Kun Lun branches into the Nanling and Tsingling Mountains of southern and central China, and these probably continue under the sea and emerge as the highlands of the four main islands that form Japan Proper. The Tien-Shan merges into the Khingan Mountains of North China and Manchukuo, and is continued in the Stanovoi, Verkhoyansk and Anadir Ranges of eastern Siberia.

In western Asia the Sulaiman Range merges into the Zagros Mountains, and the Hindu Kush into the Elburz Mountains. The Elburz, after sending out a north-western branch to form the Caucasus Mountains of Europe, joins the Zagros in the Armenian Highlands. From the Armenian Highlands the mountains branch out westwards through Asia Minor into the Pontus and Taurus Ranges of north and south Turkey.

Among these mountains of Asia there are many lofty peaks. The Himalaya contain above a dozen of more than 23,000 feet, including Mount Everest (29,000 feet), the world's highest mountain. Airmen have flown over these peaks.

"The aeroplanes seemed to be enclosed within a semi-circle of the most gigantic mountains in the world. Just to the right of our aeroplane's nose the summit of Mount Everest appeared. A little farther to the right stood the majestic Makalu. To the left was the remarkable pointed peak of Gauri Sankar. This panorama presented itself to us in its startling white beauty, glistening in the bright morning sunshine and making a magnificent spectacle."

THE MARQUESS OF DOUGLAS AND CLYDESDALE AND D. F. M'INTYRE

The highest mountain of the U.S.S.R., Mount Stalin (24,600 feet), is in the Pamir Plateau.

"In the Pamirs we found ourselves in a wild rocky country.

As we ascended, the air became cooler and more rarefied. Fast walking was a great strain and running impossible. We reached the regular snow line, and everything was dazzling white."

CLIVE BIGHAM

China's loftiest peak is in the Nanling Mountains. The Nanling form the chief range among a maze of mighty highlands in south China, where in the west there are many peaks about 20,000 feet high. The highest so far discovered is Minya Gonkar (24,900 feet) on the borders of the Red Basin. The mountains here are also known as the Szechuanese Alps.

Among the Armenian Highlands rises Mount Ararat (16,916 feet), famed for being the supposed resting place of Noah's Ark.

"We came upon the real Ararat of Scripture and history, one of the most beautiful and stately of mountains. I have seen most of the celebrated mountains of the globe, but of them all none presents a more imposing appearance than Ararat, viewed from the Araxes that washes its very base. Most lofty mountains are so situated that the summit can be seen only at a great distance, or else after much of its height has been reached. The summit of Ararat, however, can be seen from its very base, at a point only a few hundred feet above the level of the sea and at a distance as the bird flies of less than 20 miles. The mountain, therefore, rises directly before you to a height of over three miles in a wonderfully impressive manner. By reason of its nearness, its perfect symmetry, the everlasting mantle of snow that envelops the summit, all viewed through the transparent atmosphere of this region, it becomes, perhaps, the most satisfactory mountain view on the globe."

JOHN BOOKWALTER

The European centre of the young folded mountains is in the area between the boundaries of France, Germany and Italy, that is in the Alps of Switzerland. From here radiate various ranges: westwards extend the Pyrenees and Cantabrians of north Spain; southwards the Appenines that pass through Italy and emerge across the Mediterranean Sea first in Sicily, then as the Atlas Mountains of north-west Africa, and finally as the Sierra Nevada of south Spain; eastwards in two branches, one going in a



Courtesy of the High Commissioner for India
 YOUNG FOLDED MOUNTAINS - HIMALAYAN PEAKS ABOVE THE CLOUDS (page 73)



OURO PRETO

Courtesy of the Brazilian Consulate
 OLD WORN-DOWN MOUNTAINS: THE BRAZILIAN HIGHLANDS (page 80)

northerly direction to form the horse-shoe-shaped Carpathians, and the other southwards as the Dinaric Alps of Jugoslavia and the Pindus and Balkan Mountains of the Balkan Peninsula. The Balkan Range is continued as the highlands of Crimea and emerges the other side of the Black Sea as the Caucasus Mountains. These last mountains connect those of Europe and Asia, for, as we have seen, the Caucasus Range is an offshoot of the Elburz Mountains of Asia. The mountains of Europe are on a smaller scale than those of Asia; the loftiest European peaks are Mount Elbruz (18,469 feet) and Mount Kazbek (16,555 feet) in the Caucasus¹, and Mont Blanc (15,782 feet) in the French Alps.

The American Young Folded Mountains form the world's second main group of this type of mountains. They are a series of parallel ranges along the Pacific coasts of North, Central and South America.

The chief range of North America is the Rocky Mountains. These begin in Alaska as the Endicott Mountains, sweep south through Canada and the United States as the Rockies, and on through Mexico as the Eastern Sierra Madre. Parallel to and west of these run the Coast Ranges of Alaska; the Selkirk and Coast Ranges of Canada; the Cascades, Coast Ranges and Sierra Nevada of the United States; and the Western Sierra Madre of Mexico. All these mountain ranges unite in the Chiapas Highlands in southern Mexico, and thus enter Central America as a single chain; they then widen out into two or more ranges with plateaus extending between, until they end in low hills in Panama. The loftiest peak in the Rocky Mountains is Mount McKinley (20,400 feet) in Alaska. The highest summit in the Canadian Rockies is Mount Logan (19,540 feet); in the United States, Mount Whitney (15,000 feet); in Mexico, Orizaba (18,310 feet); and in Central America, Mount Tajumulco (13,800 feet) in the republic of Guatemala.

The young folded mountains of South America are the Andes,

¹ Mount Elbruz should not be confused with the Elburz Mountains; the former is in the Caucasus (Europe), the latter in northern Iran (Asia).

which sweep along the entire western part of the continent. They consist of several parallel chains that combine into one range in southern Argentina. Their highest peaks are almost as lofty as some of the giants of the Himalaya : Aconcagua (23,000 feet) on the boundary between Argentina and Chile, Coropuna (21,700 feet) in Peru, Tupungato (21,300 feet) in Chile, Sorata (21,300 feet) in Bolivia, Chimborazo (20,500 feet) in Ecuador.¹

"The cordilleras traverse the whole of South America from Panama to Cape Horn—an incredible distance, full of folds and humps. They are always equally remote, equally serene, equally overpowering, with broad tablelands in between, in wonderful untiring sweeps."

KASIMIR EDSCHMID

"If the Andes are vast in size, they are immeasurable in monotony. Unbroken by variety of colour or shape their great brown flanks lean into the distance like so many miles of scarified sand-paper. In five full days of tramping I never encountered a human being."

JAMES RAMSAY ULLMAN

"A remarkable feature of the Andes Range is that, running due north and south, or, at least, practically so, the eastward face or slope is far more steep, or abrupt, than the western. A result is that the rivers flowing eastward reach the central plains of the continent in a series of cascades and falls, many of which are of superb grandeur."

PAUL FOUNTAIN

Pakistan Zindabad

OLD WORN-DOWN MOUNTAINS.—These are called "old" because they were formed during the Caledonian and Alpaid earth movements which preceded the alpine movements by at least 100 or 150 million years, "worn-down" because owing to the combined and long action of rain, snow, ice, running water, wind, heat and cold, sometimes the mountains' former covering of sedimentary rocks has been entirely removed, leaving their granite bases exposed, and sometimes a mountain is all that

¹ In this list only the highest peak in each country is mentioned, so that the mountains do not represent the highest summits in the Andes as a whole. Peru, Chile and Bolivia each contains several mountains more than 21,000 feet in height.

remains of a former plateau.¹ In many places these mountains might have been worn down into uniform flatness if the alpine movements had not affected them by upraising and rejuvenating them.

The Old Worn-Down Mountains of the Eastern Hemisphere are situated to the north and south of the alpine systems ; it is possible that they were the obstructions that caused the earth's crust to buckle up into the alpine ranges when the continents drifted.

In the northern group are the highlands of the British Isles and Scandinavia ; the Central Plateau and the Vosges of France ; the Ardennes of Belgium ; the Black Forest, Harz, Bohemian Forest, Erze Geberge and Sudetes of Germany ; the Urals of Russia ; and the Altai and Sayan Ranges of Siberia. The highest peak in the British Isles is Ben Nevis (4,400 feet) ; and in Scandinavia, Goldhopig (8,000 feet). The summits of the Vosges reach 4,000 feet, those of the Sudetes 5,000 feet, and of the Urals 6,000 feet. The Urals form the boundary between the continents of Asia and Europe.

"From the prominence given in maps of Europe to the Ural chain, one is apt from childhood to expect in these mountains something grand. The entire length of the range is about 1,700 miles. Its highest peak however does not attain to more than 6,000 feet, and many parts of the range are not more than 2,000 feet above sea-level."

HENRY LANSDELL

The southern group of old mountains in this hemisphere are in Africa, Arabia, Peninsula India and central Australia.

"The mountain systems of the Sahara are numerous and comparatively high. The three most important groups in Central Sahara are the Tibesti, Air and Ahaggar Mountains. They have only become known in recent years, and even now have not been fully explored."

FRANCIS RENNELL RODD

"The great mountains of Tahat and Illiman (in the Ahaggar group) rise 11,000 feet above the desert and majestically dominate the group."

BYRON KHUN DE PROROK

¹ For this reason they are also known as "residual" mountains.

In West Africa there are the Cameroon Mountains where one peak is 13,000 feet high. In East Africa are many ranges, especially in Ethiopia where Ras Dashan rises to 15,000 feet, and on the Lake Plateau where Kilimanjaro rises 19,700 feet, Kenya 17,000 feet, Elgon 14,140 feet, and Margherita in the Ruwenzori Range 16,790 feet. Kilimanjaro is the highest mountain in Africa, and is thus seen by airmen :

“ Soon, from out of the placid green highlands, rose a towering height like that of a white cloud. We were droning towards Kilimanjaro, and its snow-clad slopes were clear against the stark, sunlit sky. Snow near the equator. That woolly white mass rising out of the highlands of tropical Africa was a sight as majestic as anything in the Himalaya. Kilimanjaro is a solitary mountain. It towers above everything in the vicinity. And as our aeroplane droned nearer we could see the greenish white avalanches, and that knife-edged crater frozen and sparkling in the sunshine.”

WILLIAM J. MAKIN

The chief mountains of Arabia are the highlands of Yemen in the south-west and the Akhdar Range of Oman in the south-east.

“ Here (in Yemen) is a panorama of peaks and valleys, as if some demoniacal giant had taken a sledge hammer and smashed blindly right and left, leaving an overpowering, indescribable mass—a clutter of peaks and crags, a whirl of abysses, escarpments rising behind and above each other.”

AMEEN RIHANI

The main ranges of Peninsula India are the Eastern Ghats, the Western Ghats, and the Vindhya Hills of the north which reach 3,000 feet.

“ In the very centre of India there exists a considerable region to which the term Highlands is strictly applicable, and in which are numerous peaks and ranges for which the term mountain would, in any other country, be used.”

J. FORSYTH

The highest peak among the old mountains of Australia is Mount Woodroffe (5,230 feet) in the Musgrave Range. Here the worn down summits, gentle slopes and wide valleys testify to the great age of the mountains.

"Flat-topped formations, mountain high, rise out of the plains like mighty grandstands."

CHARLES H. HOLMES

The Old Worn-Down Mountains of the Western Hemisphere are situated in the east of North and South America. The main ranges are the Laurentian Uplands of Canada, the Appalachians of the United States, the Guiana Highlands of Venezuela and the Guianas, and the Eastern Highlands of Brazil. In the Laurentian Uplands the highest summit, Four Peaks (6,000 feet), is in Labrador. The chief peaks of the Appalachian system are Mount Mitchel (6,710 feet) in the Blue Ridge Range, and Mount Marcy (5,340 feet) in the Adirondack Range. Mount Itatiaya (9,000 feet) is the highest mountain in the Eastern Highlands of Brazil.

VOLCANIC MOUNTAINS.—Volcanic activity is due to magma from the interior of the earth squeezing out through a weak spot in the earth's crust. Such activity takes place when the rocks are disturbed by heat and pressure.

"During the past ten years I have studied volcanoes, climbed volcanoes, flown aeroplanes into volcanoes, and lived inside volcanoes. These interesting features of Mother Earth are not the chimneys that many people suppose them to be, extending upward from a fiery centre of the earth. Rather they should be considered as surface eruptions, the result of chemical combustion a few miles underground. Usually iron and sulphur shaken together in great quantities start to burn. The water content in near-by rocks is thus changed to steam, whose pressure blows open the vent, whence issue the gases and exploded rock that make up a volcanic eruption."

BERNARD R. HUBBARD

Sometimes there is a single outpouring. The molten rock soaks through the surface and cools, forming a great lava field. This has happened in the Columbia Plateau of the United States, in Northern Ireland, and in the north-west of Peninsula India. But more often the action is on a smaller scale and repeated many times. The magma blows a small hole or crater in the crust, a little flows out, and solidifies in a heap round the crater. Then further eruptions occur and more lava is belched forth, and thus

a cone-shaped mountain is gradually built up. Such is the origin of volcanic mountains.

Weak spots in the earth's crust were formed during the great earth movements, for these, in addition to crumpling up parts of the surface into mountain ranges, disturbed the rock strata and caused cracks, breaks and fissures in it. All the three known earth movements had this result. But a volcano does not last for ever ; after a period of activity it becomes extinct. Therefore while among the old worn-down mountains of the world there are many dead volcanoes, with a few exceptions all the 300 active volcanoes of the world are to be found in the same zone as the young folded mountains, but of course only in those places where the crust was weakened. A ring of volcanoes in all stages of activity circles the Pacific Ocean and another group is in southern Italy. Volcanic mountains differ from others in three ways : they are due to sudden earth disturbances that may happen at any time, usually occur singly, and gradually increase in size.¹

Active Volcanoes.—Most active volcanoes constantly emit from their craters puffs of vapour (steam, smoke and gas) which glow like flames at night. Often they throw out small showers of ash or trickles of lava. Major eruptions are not frequent but they occur suddenly, and then quantities of steam, gas and magma are poured forth, and the magma flows over the surrounding country, destroying everything in its path, until it cools and solidifies.² An eruption often causes great loss of life because most volcanic regions are densely peopled, as there is no more fertile soil than that resulting from broken up and decomposed lava. But even the few volcanoes that erupt in places where there are no people cause tremendous damage, as in the following case :

“The story of the Ghost Forest of Katmai (in Alaska) is as simple as it is interesting. Until the eruption of the great volcano this region had been a sylvan paradise where bear and caribou, foxes, rabbits, and all sorts of birds and water-fowl abounded

¹ Hence they are also called “ mountains of accumulation ”.

² On land it solidifies into lava, but if it is cooled by falling into water it becomes pumice.



Courtesy of the Canadian National Railways
AN ALASKAN GLACIER (page 103)



Courtesy of the Canadian Pacific
MOUNT NGAURUHOE (NEW ZEALAND) IN ERUPTION (page 84)

amid trees, shrubs and flowers. Then came the cataclysm. A shower of sulphuric acid rained down from the ash-filled sky, completely killing, dehydrating, and preserving everything it fell on. Stark, gaunt trunks of fallen giants now sprawl about the ground. Dead trees stand upright, without leaf or foliage, without colour save the ghastly colour of death." BERNARD R. HUBBARD

Some of the greatest active volcanoes of the world are in Alaska, where the three largest craters are those of Aniatshak (which erupted in 1931), Veniaminof (which erupted in 1939) and Shishaldin.

"We groped over some loose, warm pumice rocks out of which steam was pouring. We were on top of Shishaldin, inside the great smouldering heap. Its crater, about a hundred feet in diameter, was not hollow like a chimney, but was plugged up almost level with broken, burnt-out volcanic rock. It is tamping its mighty fires within and gathering force to blow up again and become once more a beacon-light to mariners, the flaming torch of the Arctic."

BERNARD R. HUBBARD

Two noteworthy volcanoes of the West Indies are La Soufrière in the island of St. Vincent, which had a major eruption in 1812, and Mt. Pelé in the island of Martinique, which erupted in 1902.

There are several active volcanoes in Central America, among them Izalco, known as the Beacon of the Pacific; and many others in the north-west Andes Mountains of South America.

"Towards Quito (capital of Ecuador) the road passes near the famous Cotopaxi, a snow-covered, cone-shaped volcano of singular beauty, towering high up in a clear blue sky."

A. F. TSCHIFFELY

"The beauty and distinctiveness of the numerous snow-clad volcanoes is a well-known feature of the scenery of the little republic of Ecuador."

K. G. GRUBB

On the small island of Hawaii, situated about the centre of the Pacific Ocean, are four great volcanoes, the most famous of which is Mauna Loa (13,700 feet).

The western Pacific (eastern Asia) is edged with active volcanoes like the eastern Pacific (western America). In eastern

Asia they occur in Kamchatka, Japan Proper, the East Indies, and New Zealand (North Island). The eruptions in the islands of the East Indies during the last hundred years have caused much destruction.

“Merapi (in Java) is an active volcano 11,000 feet high with steam pouring from its conical top. It last erupted in 1930 with terrific loss of life and property damage to the villagers living near it.”

JULIUS FLEISCHMANN

“The mass of green islands to the right of the Sunda Straits (Sumatra) look fertile and seductive, but they are uninhabited. They have a sinister name in history. Among them is Krakatau, ill-famed for the greatest eruption the world has ever known. 40,000 human beings lost their lives in the eruption of 1883 and in the tidal wave which accompanied it. Krakatau is still active, still emits smoke and throws up great spouts of water.”

R. H. BRUCE LOCKHART

At the southern end of the Pacific Ocean, in Antarctica, towering volcanoes are landmarks to explorers.

“As the afternoon wore on the great volcanoes of Ross Island appeared—Erebus, Terror, Bird and Terra Nova—one of the most superb scenic views in the world. Most of all we were struck by the massive beauty of Mt. Erebus (13,200 feet), an active volcano standing at the gateway of the Barrier, its flanks veined with glaciers, and a plume of vapour floating above its cone.”

RICHARD E. BYRD

The active volcanoes of Italy are smaller than those of the Pacific. Stromboli, the “Lighthouse of the Mediterranean”, is on the island of that name in the Lipari group; a minor eruption occurred in 1938. Mount Etna (10,870 feet) in northern Sicily suffered a major eruption in 1910. A much visited volcano is Vesuvius (4,000 feet) a few miles from Naples, for near it are the remains of the Roman city of Pompeii which was buried by lava during an eruption of Vesuvius in the first century. Visitors sometimes climb the mountain to see the destructive crater at close range.

“The air (at the summit of Vesuvius) seemed filled with a

faint, hissing, crackling sound, and when I breathed deeply I caught the smell of burning sulphur. I heard a hoarse breathing, as though a mighty locomotive was about to start on a journey, and somewhere in the mists that rolled about the crater I saw a glimpse of flame."

ROLAND ANDREW

Geysers and Hot Springs.—In regions where active volcanoes become extinct, they are often succeeded by geysers, hot springs and pools of boiling mud. In the Yellowstone Park of the Rockies in the United States there are thousands of hot springs and geysers, the remnants of former volcanic activity. Others are found in the Caucasus Mountains of Europe, where the Russians have built holiday resorts and rest houses.

"There are many hot springs both north and south of the Caucasus Range; there are also many cold mineral springs. These hot and cold sulphur and iron springs, and alkaline, iodine, and bromine springs and others, have been known from olden times for their healing powers. Tradition has it that even Alexander the Great's men benefited by some of them."

FRIDTJOF NANSEN

The most famous centre in the world for geysers and hot springs is at Rotorua in North Island, New Zealand. Almost every visitor to the country expresses a desire to see this thermal region.

"It is in truth a valley of the marvellous—geysers, mud volcanoes, boiling springs, a large bright green pool that emits the most alarming cracklings and groans, a mud crater that casts up a dark fluid with sounds at intervals like the booming of a cannon, steam blow-holes and fantastic formations, all are contained here in this narrow secluded valley that is hidden among the lonely scrub-lands of Lake Taupo. Perhaps the most wonderful and awesome of all its many sights is the huge cauldron which lies at the base of a great concave cliff of bright red hæmatite. This pool has clear saline water with a temperature of over 270° F. that is constantly bubbling and hissing and rising and falling with terrific rumblings amid dense clouds of steam."

H. M. VAUGHAN

"Near the middle of the valley we come upon the geysers, which are quite high mounds, each of which has a hole in the apex. We wait and wait. Just as our patience is wearing thin



ROTORUA

Courtesy of the High Commissioner for New Zealand
 BOILING MUD (page 85)



ROTORUA

Courtesy of the High Commissioner for New Zealand
 HOT SPRINGS (page 85)

there come, from the mound, strange gurgling sounds. This is followed by subterranean rumblings. The gurglings, garglings, and rumblings rise almost to a crescendo, and the geyser explodes. A stream of boiling water and steam is flung high into the air, to fall to earth in a thousand graceful streams." S. E. G. PONDER

"In this zone you are in a realm of sulphur. It is in the air as well as the water, tickles your throat, and blackens the silver in your pocket."

W. PEMBER REEVES

Earthquakes.—Volcanic regions are subject to earthquakes, though the earthquake belt is wider than the volcanic one because it covers the area of extinct as well as active volcanoes. Earthquake zones therefore cover not only the lands bordering the Pacific Ocean, but also extend through southern Asia across the Himalaya, the Pamirs, Iran, Syria, Caucasasia, Asia Minor, the Balkan Peninsula, Italy and Spain. Earthquakes are not connected with volcanoes but arise from the same causes, weakness in the earth's crust and disturbance of the magma.

Slight earthquakes are extremely common occurrences. Seismographs (instruments that measure the extent of earth tremors) register minor quakings of the earth practically every day. Major earthquakes occur seldom, but usually cause great destruction and loss of life. During the present century there have been earthquake disasters of a severe type at San Francisco (1906), Tokyo (1923)¹, Managua in Central America (1931), Quetta in north-west India (1935), Rabaul in New Guinea (1937), Concepcion in central Chile (1939), Erzingan in east-central Turkey (1939).

¹ Tokyo's great earthquake of 1923 is easily not only the worst Japan has experienced, but the most disastrous the world has yet known : over 700,000 houses were destroyed and more than 100,000 persons perished. Earth tremors indeed are common in Japan, and rarely a decade passes but some earth disturbance causes loss of life and property. During the nineteenth century altogether 18 serious earthquakes were registered, and about 304,000 houses were destroyed and 64,000 lives lost. These were the official figures published by the Japanese Government.

The following descriptions of earthquakes in various parts of the world may be of interest to those who have not experienced them and have therefore thought the earth is stable under their feet.

"I was lying down in the wood to rest myself. It came on suddenly and lasted two minutes. The rocking was most sensible; the undulation appeared both to me and my servant to travel from the east. There was no difficulty in standing upright, but the motion made me giddy. I can compare it to skating on very thin ice or to the motion of a ship in a little cross ripple. An earthquake like this at once destroys the oldest associations; the world, the very emblem of all that is solid, moves beneath our feet like a crust over a fluid."

CHARLES DARWIN

"It happened on a bright, sunny morning. Sitting on the verandah, we enjoyed our forenoon tea. Suddenly was heard a growing rumble and almost simultaneously a gradually increasing tremor set the china rattling. Then we were all on our feet clinging to the verandah rail. Fierce shocks of ever increasing violence were accompanied by a thunderous noise and the roar of distant explosions. We were thrown against each other. The house swayed hither and thither, and from within was heard through the general crash the terrific rumble of the chimneys collapsing. But presently the shocks subsided, only a light tremor remaining for some time."

ERLING TAMBS

"I had always supposed that an earthquake was a weakness on the part of the earth, and that the feeling would be one of floppy giving way. On the contrary the feeling was indescribably tense and energetic, as though the gods clenched their fists. All the eucalyptus trees outside bowed and drew a hissing breath."

STELLA BENSON

HOW MOUNTAINS AFFECT MANKIND.—Mountains occupy one-third of the land on which man has made his home. They prove obstacles to easy communication and transport, and keep out winds that might bring warmth or rain, but at the same time they act as barriers against invasion, and provide shelter from

cold winter winds. Apart from these disadvantages and advantages, mountains are useful to mankind in a number of ways.

Their lower slopes, even when forming hills and hillocks, can be used for agriculture (except of course in polar regions where they are always snow-covered). Although cultivation of mountain slopes entails much work, for the ground has to be terraced to make level surfaces, nevertheless the opportunity is welcomed in densely populated countries such as China and Japan.

“Up the ravines of China the terrace cultivation witnesses to the constant toil and trouble of the industrious Chinese farmer.”

JOHN GRANT BIRCH

“One of the most striking features in Japan is the extraordinary and minute care with which the hills are terraced from base to summit wherever a single grain of rice or other cereal can be made to grow.”

WALTER WESTON

Above the lower slopes mountains are forested up to a good height in most regions. The timber obtained from the trees is used for building, fuel, pulp and paper making. Among and beyond the forests the slopes are grass covered and provide summer pasture for sheep and cattle.

The more one rises the thinner and therefore colder the air becomes. In tropical countries where the heat is unbearable at sea-level, the mountains afford places where people can keep cool and live comfortably. Moreover, rarefied air does not hold dust like the heavy and sometimes oppressive atmosphere at sea-level, so that at heights of several thousand feet it is cleaner and healthier, invaluable to convalescents needing rest and sunshine and pure fresh air. This is one reason for the popularity of the Swiss Alps in Europe.

But mountains may be ascended only up to a certain height in search of “better” air. At 12,000 feet people unaccustomed to breathing rarefied air and enduring less atmospheric pressure are attacked by mountain sickness, drowsiness and inertia, and farther up movement becomes difficult and gradually impossible.¹

¹ Only a comparatively small part of the land surface of the world (about $\frac{1}{30}$) is situated at heights of 12,000 or more feet.

Even experienced mountaineers find such heights not very pleasant.

"The altitude of 20,700 feet made itself felt. The slightest exertion in moving brought on a prolonged bout of panting. The cold as well as the rarefied atmosphere slowed us down, until every action was done at one-third speed."

A. B. EMMONS

PLAINS AND PLATEAUS

PLAINS cover about a quarter of the land surface of the earth. They are expanses of flat or gently undulating land situated at low altitudes above sea-level, and have originated in various ways. Some are due to the gradual wearing down and flattening out of mountainous areas, some have been formed by the upraising of the sea-floor, some have resulted from soil and rock waste being carried from highlands by rivers and deposited in their lower courses, some are caused by the filling or drying up of former lakes and swamps, and some (coastal plains) are formed by the action of wind and waves either slowly wearing back the shores or piling up material on the margins of the land.

A vast plain stretches from west to east across central and northern Europe and Asia, extending from the Atlantic Ocean almost to the Pacific. Parts of it are known as the Central European Plain, the Siberian Plain and the steppes.

"Beyond is the vast sweep of the steppes. The immensity of the plain flowing away to the skyline in all directions is overwhelming."

ETHEL MANNIN

There are great plains in central Australia and the eastern half of South Island, New Zealand. Plains also extend from north to south through the Americas.

The North American plains are called prairies, and are bounded by the Rocky Mountains in the west and the Laurentian Highlands and Appalachian Mountains in the east.

"We look around and see nothing but a boundless sea of grass, a verdant undulating ocean stretching to the far distant horizon

in one vast perpetual sweep. An overpowering sense of vastness is conveyed to us as we speed over these immense plains."

W. G. MARSHALL

"We were able to stop the car and have a look at the Nebraskan plains that lay before us in the sunlight. The country was not unlike the Somme country of France.¹ There were the same gentle slopes and rolls of ground, the same dotted farm-houses, and the same wooded valleys. The difference was a difference of colour, for Picardy is white with chalk and its green is a dusty, chalky green, whereas Nebraska (central United States) is black with the blackness of its soil, and its green is dark and rich, except where the winter wheat makes a lighter splash of colour . . . Far away, beyond the Elkhorn River, Nebraska stretched to the horizon and for many a hundred mile beyond the horizon."

A. G. MACDONELL

In South America the plains are given different names according to their type of vegetation : the llanos (tropical grasslands) of the Orinoco Basin ; the selvas (equatorial forests) of the Amazon Basin ; the Chaco (tropical grasslands and forests) of southern Bolivia, western Paraguay and northern Argentina ; and the pampas (steppe-like lands) of central Argentina, eastern Paraguay and Uruguay.

"In whatever direction one leaves Buenos Aires (capital of Argentina) by land, there is a tremendous spread of flat lands to be covered before town or port or hill or river is encountered."

L. E. ELLIOTT

Plains that are connected with rivers are found in many parts of the world. A noteworthy example is the Great Plain in northern India, watered by the Indus and Ganges Rivers.

"It stretches in one vast flatness across the north of India from the mouths of the Ganges on the east to the mouths of the Indus on the west, and a distance of some 1,500 miles, except for the dry and sandy tract, known as the Indian Desert, which lies between the valleys of these two great rivers."

LADY HARTOG

¹ The River Somme is in the province of Picardy in northern France.

Other such "river" plains in Asia are : Mesopotamia (drained by the Euphrates and Tigris Rivers), the basin of the Irrawaddy River of Burma, the lowlands of the Rivers Menam and Mekong in Indo-China, the North China plains of the Yangtse-kiang and Hwang-ho Rivers, the Manchukuo Plain drained by the Sungari and its tributaries.

In Africa the economically valuable part of Egypt is the plain watered by the great River Nile. In Europe there is the Lombardy Plain of the River Po in northern Italy, and the Hungarian Plain circled by the Carpathian Mountains and drained by tributaries of the River Danube.

Plains, especially the "river" plains just mentioned, are the most easily developed regions of the world. Because they are practically level, communication and transport are easy ; because they are largely composed of rock waste, their soils are usually deep and fertile. It is in these areas that civilisations first grew and prospered.

PLATEAUS are high plains, that is, level expanses of land situated at high altitudes. Usually a flat area more than 600 feet above sea-level is described as a plateau, but there are some exceptions to this rule. The western prairies of Canada and the United States, for instance, are really plateaus, for they are 2,000 feet and more above sea-level, but since they are the continuation of the lower eastern prairies and their rise is gradual, they are invariably grouped with the eastern regions and with them classed as plains.

Plateaus are caused by the wearing down of mountain summits, the upraising of plains, the collection of great amounts of rock waste, and the welling out of lava from the earth's crust.

The highest plateaus of the world are situated among the loftiest young folded mountains—in western South America and Central Asia. The Altiplano of Bolivia and Peru in South America extends between parallel ranges of the Andes with a width of 200 miles and an elevation of 12,000 feet. The plateau of Tibet in Central Asia is the highest in the world ; it has an average

altitude of 16,000 feet and lies to the north of India, between the Himalaya and the Kun Lun Mountains.

“So level is the plateau here and so clear the atmosphere that we could plainly see a tiny village about 12 miles away, and we wondered why we did not get there sooner.”

F. KINGDON WARD

Other plateaus in Asia are : the Tsaidam Basin between the Kun Lun and Nan Shan Mountains, the Tarim Basin between the Nan Shan and Tien Shan Ranges, the Mongolian Plateau between the Altai and Khingan Mountains ; and practically the whole of southern India, western Iran, Arabia and central Turkey. Among these the Arabian tableland is the largest.

“Words cannot express the desolate aspect of this vast tableland. It is practically level, and strewn with black lumps of basalt, looking as though a gigantic coal-scuttle had been upset. Occasionally there rises above the plain a flat-topped mound or ridge some 80 feet high.”

THEODORE BENT

In Australia the Western Plateau has an average elevation of 1,000 feet and covers almost two-thirds of that continent.

The whole of Africa, with the exception of the Nile Basin and narrow coastal plains, consists of plateaus of varying heights : the Sahara Desert in northern Africa (average altitude 1,000 feet), the East African Plateau (5,000 feet), and the South African High Veld (4,000 feet), Great Karroo (2,000 feet) and Little Karroo (1,000 feet).

“Africa is represented roughly by a series of circular steps forming the base of a monument. There is a low-lying coast line varying from one to several hundreds of miles in extent. Then follows a series of escarpments leading to the great central plateau extending for some thousands of miles, and broken by huge rivers and lakes, and some fairly high mountains.”

HENRY AND WALTER MASTERS

“Ethiopia is practically a series of extensive plateaus, rising one from the other from the south and east, and culminating in the high mountains of Simien in the south, which are over 16,000 feet above sea-level. These plateaus are separated by

deep rifts or canyons, the valleys of rivers which carry off the large annual rainfall."¹

E. J. BARTLEET

Europe contains only one large tableland, the Spanish Meseta, which covers the interior of the Iberian Peninsula ; it has an average elevation of 2,000 feet.

North America has many plateaus among the parallel ranges of the western mountains. The Yukon Plateau occupies the entire interior of Alaska. In the United States the Columbia Plateau, Great Basin and Colorado Plateau extend between the Rockies and the Coast Ranges. Except for narrow coastal plains the whole of Mexico lies at an altitude of from 4,000 to 8,000 feet.

"The great elevation of all the plateaus about the Rocky Mountains is perhaps the principal cause of the extraordinary dryness of the atmosphere."

J. GREGG

Plateaus occupy the interior of Central America, and occur in South America in the east among the Brazilian Highlands, in the south of the continent where the Patagonian Plateau stretches from the Andes almost to the Atlantic Ocean, and among the parallel ranges of the Andes Mountains in Peru and Ecuador.

"The beauty of the Ecuadorian plateau is a stern beauty : the beauty of harsh mountains, and of great sterile distances, seen through the medium of lofty desert air."

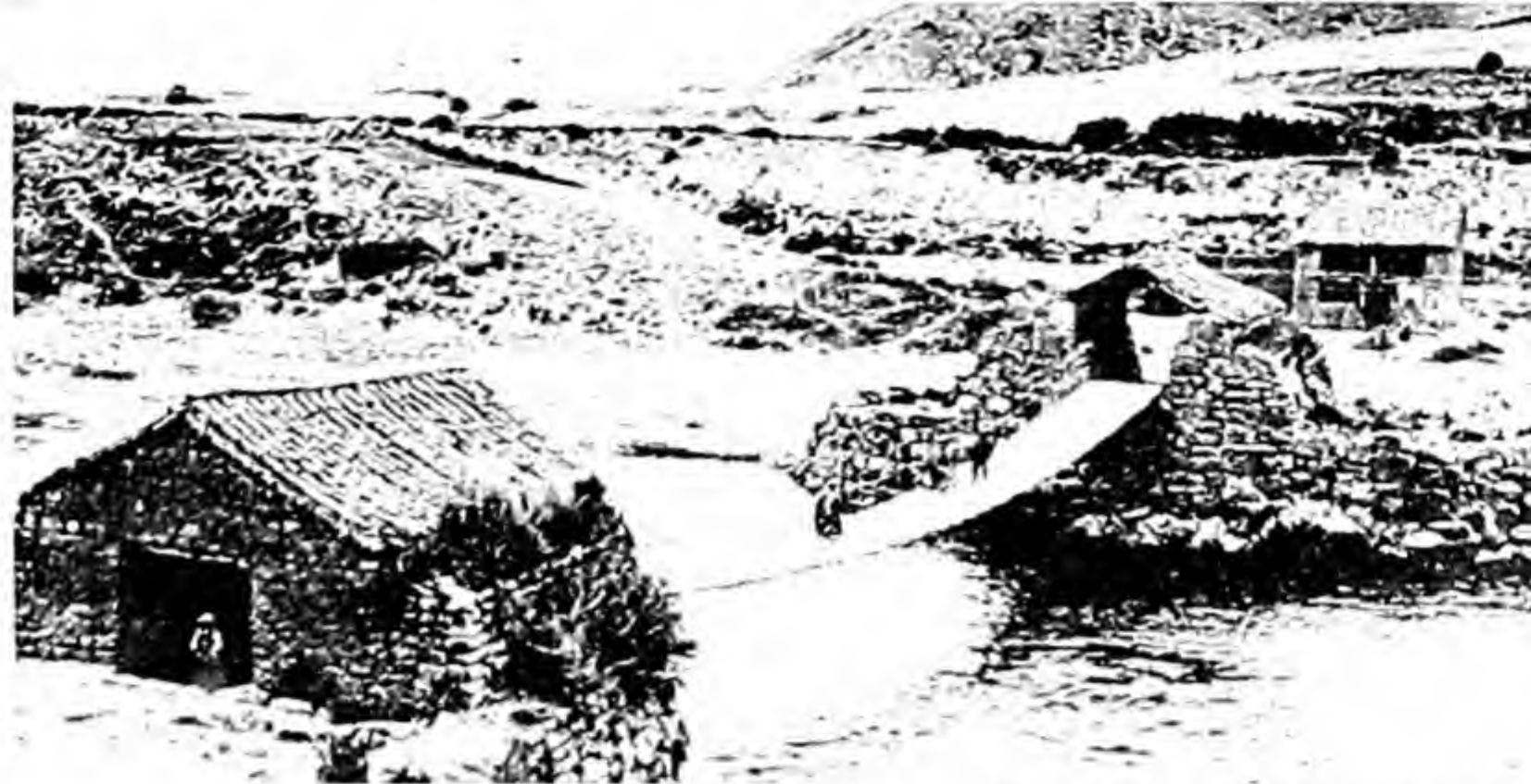
BLAIR NILES

In the polar regions noteworthy plateaus are those of Greenland in the northern hemisphere and Antarctica in the southern hemisphere. Ice-covered Greenland, except for its coastal areas, is believed to be a plateau with an altitude of 8,000 feet. The frozen wastes of Antarctica are also thought to form a plateau.

"Antarctica is mainly uplifted tablelands of snow and ice, from 5,000 to 10,000 feet above sea-level, and is traversed in places by mountain ranges of extraordinary size and beauty."

RICHARD E. BYRD*

¹ When describing plateaus as practically "level", we usually do not take into consideration the mountain ranges and valleys on them. This is because firstly, although the mountains may be more than 10,000 feet above sea-level, their actual heights above the plateaus often are only a few hundred feet, and secondly, these irregularities are few and tiny compared with the vastness of the land.



Courtesy of the Peruvian Government
 A VIEW ON THE ALTIPLANO (page 92)



Courtesy of the Swiss Federal Railways
 A VALLEY AMONG THE ALPS (page 96)

There are many smaller plateaus in almost all the mountainous regions of the world : Central Switzerland is a tableland among the Alps of Europe, and there are numerous others in the Rocky Mountains of western Canada.

Despite their flatness, plateaus are not as useful to man as level lands at lower altitudes. They receive much less rainfall than the neighbouring lowlands, for moisture-bearing winds drop most of their rain while rising to cross the highlands, and thus blow over the plateaus as dry winds. Sometimes the rivers flow through deep channels, making irrigation and transport difficult. The climate of plateaus is much colder than that of plains ; this is a disadvantage in temperate countries from an agricultural standpoint, but an advantage in tropical lands (such as East Africa, Mexico and Central America), where the bulk of the population as well as European settlers shun the blistering heat of the lowlands and live on the cool highlands.

VALLEYS AND DEPRESSIONS

VALLEYS have varying widths and their sides are of different degrees of steepness according to the type of country in which they are situated. As they are sheltered by their neighbouring highlands, their climate usually is milder than that of the land surrounding them. They prove good places for habitation if they are not too narrow and steep sided, and if communication with the outside world is easy.

Valleys are mainly due to streams and glaciers hollowing out paths for themselves when flowing from higher to lower levels, and to earth movements forming gorges between the ranges of mountains that are crumpled up. Such valleys are found in all mountainous districts and here and there among plains and plateaus.

There is, however, another kind of valley, due either to the rising of two areas standing parallel to each other, when the space between them becomes a chasm, or to the sinking of a region much below the level of the surrounding land. Places formed in these ways are known as "rift" valleys. In Germany

the River Rhine flows through a rift valley between the Vosges and Black Forest ; Lake Baikal in Siberia is situated in another ; Lake Eyre in South Australia in yet another ; and there is the remarkable Great Rift Valley, the biggest in the world, that extends through Palestine, the Red Sea, Ethiopia and the East African Plateau.

"The Great Rift can be traced from Beira, in Portuguese East Africa, northwards to Lake Nyasa, where it apparently divides into a western branch and an eastern branch. The bed of the former valley is filled by the chain of Central African lakes, Tanganyika, Kivu, Edward and Albert. The eastern valley resembles an immense gash across the vast spaces of Tanganyika and Kenya to Lake Rudolf, through Ethiopia, across the Red Sea to the Dead Sea, and up the valley of the River Jordan."

CHARLES DOMVILLE-FIFE

"It is, though a trough, many miles wide, with flat bottom and steep parallel sides, and it generally has little or no connection with the main river-drainage of the area."

JULIAN HUXLEY

"The Titanic gulley is nearly straight, and has a length of some 1,800 miles, so that if located in Europe it would extend from London to Istanbul. It varies in width from 30 to 50 miles. In the level floor of the valley are many lakes. It presents also immense extinct volcanoes."

SIR FREDERICK TREVES*

DEPRESSIONS are valleys situated below sea-level. The most famous of these are Death Valley in California (280 feet below sea-level), the Dead Sea Valley of the Palestine section of the Great Rift Valley (1,290 feet below sea-level), and the Turfan Depression of Central Asia (1,000 feet below sea-level). Such areas have in summer tremendously high temperatures and suffer from lack of rainfall.

"We were going down and down, into the famous Turfan Depression, a drab desert plain, bounded on the north by the red and yellow hills through which we had descended. Now, in November, it was cold enough. But in summer the heat is terrific."

SIR E. TEICHMAN

THE CHANGING SURFACE OF THE EARTH

DENUDATION AND DEPOSITION

We have seen that it is possible to distinguish between the young folded mountains and the old worn-down highlands from the way the old mountains have been weather-worn, rounded, and denuded of much of their covering soil and rock. This denudation causes great changes on the earth's surface, for in the course of time enormous amounts of soil are carried away and gradually deposited in flat and hollow places, and thus mountains are slowly worn and flattened out, valleys deepened or widened, new lakes excavated or old ones filled up, and plains destroyed or built up. Denudation and deposition are responsible for as much alteration on the surface of our globe as the periodic earth movements, the only difference between them being that the effects of the former are very slow and practically imperceptible at the time, whereas those of the other are comparatively quick.¹

¹ These "quick" earth movements are of two kinds: one due to the drift of land causing the formation of mountains and valleys, the other to the rise and fall of land, which phenomenon sometimes causes a "rift" valley, and sometimes a slight elevation or depression discernible where the land bears signs of having once been the bed of a sea or where structures built on dry land are now partially or wholly submerged. Even when these changes are effected in hundreds of years they are considered quick in comparison with those due to denudation and deposition which usually take millions of years. Actual rising or lowering of land over a period of several hundred years has been observed in Scandinavia, the northern part of which has been calculated to be gradually rising and the southern part sinking, and it has been also noticed in Egypt, where Cleopatra's baths, built about 2,000 years ago on the coast at Canopus (near Alexandria), are now wholly submerged though still visible from above the water. Among quicker types of earth movements may be mentioned the remarkable disturbances in 1878 and 1888 at Port Resolution, Tanna, New Hebrides, where a total elevation of about 80 feet was noted by missionaries; and noteworthy also is the earlier event that affected an area of about 4,500 square miles in New Zealand:

"On the 23rd January, 1855, a sudden elevation of the land took place in the neighbourhood of Wellington; the land rose about 8 feet, sinking again afterwards 3 feet, so that the permanent rise was 5 feet. On the other hand, the west side of Cloudy Bay, north of Blenheim, was depressed to the extent of 5 feet."—G. Hogben, *The Geography of New Zealand* (by P. Marshall and others).

The forces or agents of denudation and deposition are mainly air (temperature and wind) and water (rain, running water, sea and glaciers).

Effect of Temperature.—Heat causes almost all things, including rocks, to expand, and cold makes them contract. When changes from heat to cold or cold to heat are sudden, rock masses crack under the pressure of quick expansion or contraction, and in due course fall to bits.

“It is here in the Ahaggar Mountains that one hears that strange phenomenon of the Sahara—the rifle-like bursting of the rocks. Due to the great heat of the day and the sudden dropping of temperature to freezing point at night, the swift change causes the rocks to burst.”

BYRON KHUN DE PROROK

“The Western Karakoram (Central Asia) is notorious for its still unsettled geological condition, and here the process of settlement is still going on. Rocks were insecure, stones gave way, and the formation and relief were still being stabilised. This want of permanency was very evident as we went up the pass. The huge rocks, many feet high, were splitting and tearing, and the appearance of the ascent must alter considerably in a few years. Indeed, in many places the crags were so insecure as to be unsafe. Their ruggedness tends to disappear as the boulders and outcrop crumble and mix with the other débris.”

R. C. F. SCHOMBERG

Effect of Wind.—The air is always full of tiny particles of dust and grit. When there is a wind these are carried for many miles, sometimes across large expanses of sea.

“Near to Las Palmas (Canary Islands) there is much sand, blown across the intervening sea from the Sahara.”

CHARLES DOMVILLE-FIFE

Dust blown against rocks slowly wears away the softer parts, carving the rocks into strange shapes. In some mountainous areas rock bridges have been formed in this way, several of them of immense size, such as the famous specimen in the United States.

“This marvellous example of the effect of natural erosion, Rainbow Bridge, lies hidden away in the depths of a great gorge

tributary to the Grand Canyon of Colorado. With perfect symmetry it rises 310 feet from the depths of the gorge, which it spans with a width of 278 feet."

ROBERT FROTHINGHAM

Effect of Rain.—There is enough carbon dioxide from the air dissolved in rain to turn it into a weak acid. Rain falling on or beating against rocks and soaking into them, owing to its acid content, causes the rocks, even the hard ones, slowly to decompose. For instance the granite in parts of Cornwall, after centuries of gentle showers of rain, has disintegrated into sand and kaolin (a clay used in making porcelain).

Running Water gradually scrapes and carries away the surface soil in its path, and in rivers the colour of the soil thus carried usually tinges the water.

"The Rio Grande near Santa Cruz (Brazil) is the dirtiest river I ever saw, fast and shallow, opaque with the loam it has scraped from the banks in its scurry towards the Amazon."

J. DUGUID

"As one steams in from the Yellow Sea westwards across the Gulf of Pechile, the muddy waters of the Tientsin or Pei-ho River come far out to meet us, tinging the ocean to the same dingy, yellow-brown hue as the shores of the Great Plain of China."

ELIZA RUHAMAH SCIDMORE

Even comparatively small rivers, such as the Thames, carry remarkable amounts of soil and minerals in their waters.

"The Thames carries down to the sea every year fourteen million cubic feet of solid matter. Imagine a huge die-shaped mass of stone measuring 100 feet in length, 100 feet in width, and 100 feet in height: this would contain one million cubic feet. No fewer than fourteen of these gigantic cubes appear to be quietly stolen from the surface of the Thames Basin by means of running water and transported to the sea every single year."

T. H. HUXLEY

We do not notice large lumps of earth missing from our land because very, very little is taken from each square yard (perhaps a few grains every week), and it is only the combined amounts from thousands of square miles over a long period that make the millions of cubic feet of solid matter.



RAINBOW BRIDGE (page 99)

Courtesy of the Santa Fe Railway



COASTAL EROSION (page 109)

Crown Copyright, Courtesy of the Geological Survey and Museum

“The entire surface of the Thames basin is reduced in level by only $\frac{1}{800}$ th part of an inch every year. Therefore denudation can have lowered the average surface of the Thames basin by hardly more than an inch since the Norman Conquest (1066); and nearly a million years must elapse before the whole basin of the Thames will be worn down to sea-level. Thus it has been calculated that, at the present rate of denudation, it would require about $5\frac{1}{2}$ million years to reduce the British Isles to a flat plane at the level of the sea.”

T. H. HUXLEY

Rivers that carry much silt and flow quickly, deepen and widen their valleys, for the silt scours the sides and bottom of their beds. The greatest instance of such erosion is the Grand Canyon in the western United States, where the Colorado River has worn away a channel for itself more than a mile deep.

“I am looking down into the Grand Canyon of the Colorado from the plateau one and a half miles high, which forms this portion of Arizona. To gaze for long into this shadowy gorge causes a physical dread, and to look across the cliffs on the opposite side creates a feeling of awe. The river is the maker of this gigantic canyon.”

CHARLES DOMVILLE-FIFE

Rivers that flow slowly deposit their silt either in their beds or at their mouths. An example of the former is the Hwang-ho River in China, the bed of which has gradually risen so that now the river, propped up by embankments, flows on a higher level than the surrounding country, and at high water there is always danger of flood.

All rivers deposit waste matter at their mouths, the extent of the deposits being determined by the speed of the waters. In many cases tides or ocean currents carry the silt far from the land, but in others it gradually banks up, forming deltas or sand bars which in the course of time get bigger. For example Holland owes its existence to the silt carried by the Rhine; the delta of the River Danube is increasing at the rate of about 100 yards a year; other large deltas are those of the Rivers Nile and Mississippi. The formation of deltas is perhaps Nature's way of compensating in some measure for the ground lost by denudation.

The Sea, according to the strength and direction of the tides, in some places slowly eats away the land and wears back the shore, and in others gradually piles sand and stones and thus builds up a wider coastal plain.

Glaciers cause perhaps more changes on the earth's surface than any other single agent. Glaciers are solidified masses of accumulated snow which, under the pressure of more and more snow, change into ice, and are forced forward like rivers, but flow only at a speed of about a foot each day. These ice-rivers are found in the polar regions and at altitudes where it is too cold for snow and ice to melt.

As glaciers flow down the hillsides, they scrape and grind away the ground along their paths, both beneath and at their sides, and lumps of soil, pebbles and stones of varying sizes break off and get onto and into them and are carried away by them.

"Every winter adds to the weight of snow above ; every heart-beat marks a downward movement of the mass. What we call the ' eternal hills ' are being ground to grey powder ; ledges of rock are being undermined and will crash down the hillsides in clouds of dust and showers of stones. Whilst we sit here, vast blocks of ice get detached and fall in columns of smoke with a noise of thunder. The process of rubbing, grinding, breaking is always going on. If you can stand still and listen you will hear the pebbles falling like the drip of rain." J. RAMSAY MACDONALD

The rocks and soil that fall onto the glaciers from their sides form on the flowing ice long lines of *débris* known as *moraines*. Sometimes parts of the glaciers are practically covered with these moraines.

"The Banke Glacier, like the majority of the main Himalayan ice-streams, is covered in moraines for the greater part of its length, and presents a dreary but not unimpressive spectacle of mountain decay."

F. S. SMYTHE

In places where glaciers melt before reaching the sea, the moraines brought by them gradually pile up into high banks, sometimes even forming hills, and the stones carried beneath them, if finely ground in transit, give fresh fertility to the soil where they are deposited.

The glaciers of the great Ice Age of more than a million years ago changed in many places the physical features of our globe ; for instance, the thousands of lakes in Finland and the innumerable fiords of Scandinavia were scooped out by ice-streams, many of the southern hills of these countries are former moraines, and the prairies of North America owe their fertility to drift-soils deposited by glaciers.

In the polar regions where glaciers reach the sea without melting, pieces of them break off and float away as *icebergs* to warmer latitudes, where they melt and lay their burdens on the bed of the sea. These icebergs, many of them of immense size, are a danger to vessels when they reach the shipping routes, and patrol boats are engaged by several governments to give timely warning of their approach.

“ A loud report echoed over the silent waters. About a mile away I saw the birth of an iceberg. The vast glacier, having its origin high up among the peaks far inland and filling the valley down to the edge of the sea, shed a mass of ice several hundreds of feet thick, which floated away as a free berg.”

CHARLES DOMVILLE-FIFE

“ The North has its bergs, but compared with those of the South they are the merest splinters, with the exception perhaps of a few that have their origin in Greenland. Another name is really required for the southern bergs, for, in truth, some of them are young continents. Specimens that are merely a few miles in extent are an everyday sight. Others of 40, 50, 100, even 150 miles in length have been recorded. The home of these monsters is the Great Barriers, the fringing glaciers of Antarotica.”

A. G. BENNETT

EXERCISES

1. What are : a contour map, geyser, earthquake, volcano, river plain, plateau, rift valley, delta, glacier?

2. Write a short account of the causes of denudation and deposition.

3. What are the chief advantages and disadvantages of living in a mountainous district?

4. Why was it that the earliest civilisations arose on river plains?

5. Rewrite, filling in the missing words :

The mountains of the world can be divided into three groups : the lofty — — mountains caused by the most recent earth movements (the Himalaya, —, —, —), the lower — — — mountains due to earlier earth movements (the — of Russia, the — of North America, the mountains of — —), and — mountains built up by sudden local earth disturbances (Mount Vesuvius of —, Mauna Loa of —). Great plains extend from — to — across central and northern Europe and Asia, and from — to — through the American continents. The surface of the world is always — changing. Sudden — of — cause rocks to crack and break ; winds and rivers wear away the — and — the worn off particles elsewhere ; — causes rocks to disintegrate ; the sea in places — — the land, in others builds up — coastal —.

COMPOSITION

“ As Firm as a Rock.”

LOCAL STUDY

Write an account, with sketches and a sketch map, of the relief of your neighbourhood, noting especially any examples of erosion.

HANDWORK

In a sketch map insert : the Pamir Plateau, Himalaya, Andes, Rockies, Alps, Caucasus Mountains, East African Plateau, Pyrenees, Appenines.

GAME

A number of statements are made bearing upon this chapter, some correct and some incorrect. The one who answers them correctly with explanations provides the next series of statements. Examples :

The Andes are in the east of South America. (No)

An iceberg is not a river of ice. (Yes)

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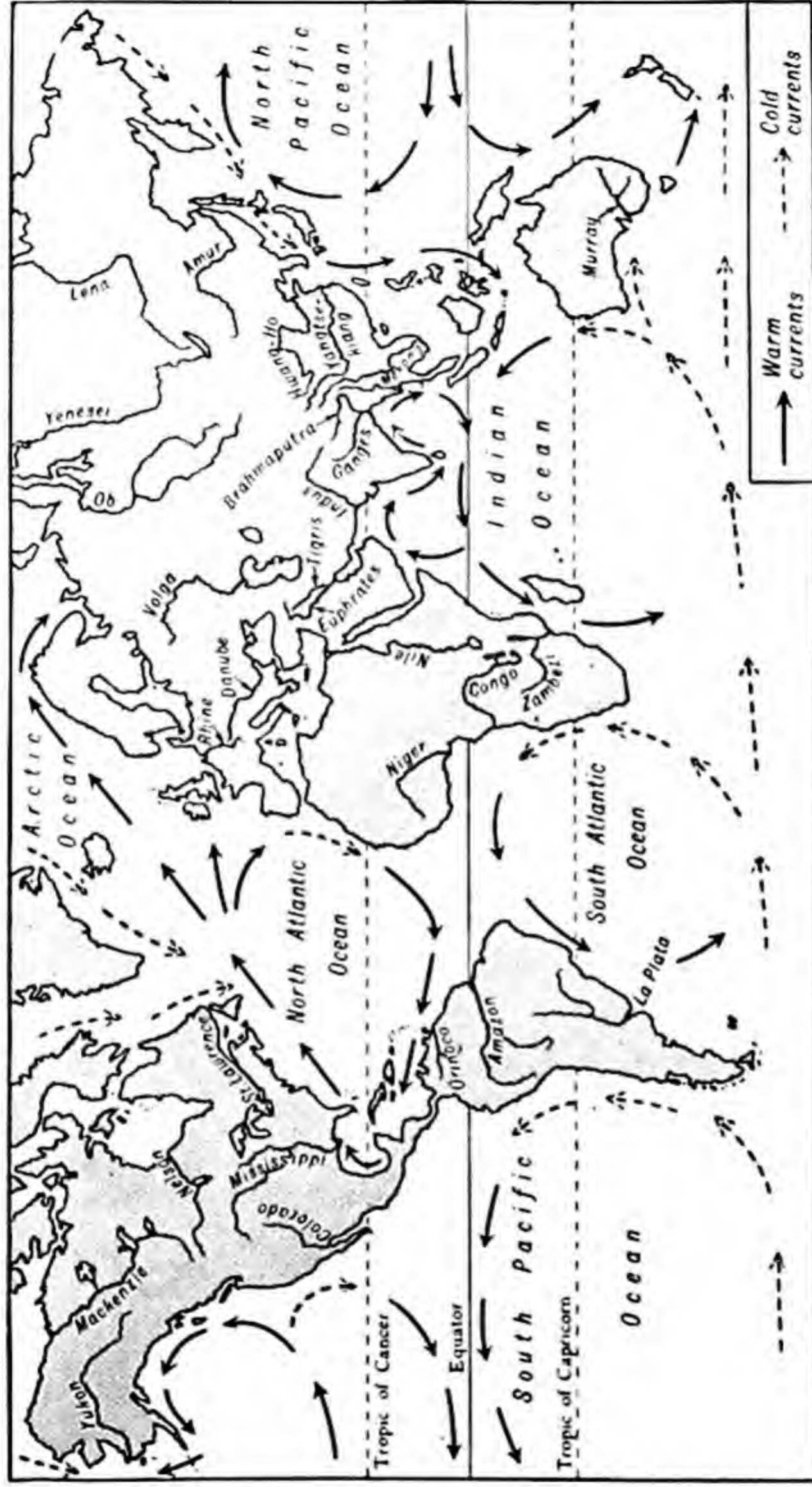
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CHAPTER FIVE

THE END OF THE WORLD



THE WORLD'S CHIEF RIVERS AND OCEAN CURRENTS

CHAPTER FIVE

WATER

The water surface of the earth is known as the hydrosphere. Of the earth's total area of 200 million square miles, oceans and seas occupy 140 million, and rivers and lakes 3 million.

The sea is used as the basis for calculating the height of land masses. We speak of mountains being so many feet above sea-level. This is a relic of the old theory that the seas and oceans have the same level all over the world. But modern researches are throwing new light on this subject.

“Sea-level is certainly an odd and misleading term to apply to something which is continually altering. What is more interesting, is the great difference or diversity of sea-level in different parts of the world. When ships leave continental shores for the open ocean they are literally sailing downhill, for the simple reason that the water is piled up towards such coasts by the gravitational attraction of the mountain masses. Do not therefore run away with the notion that the sea is really level, like a tennis court. It is full of ups and downs—undulations vastly larger than the waves that can be seen.”

CYRIL HALL

OCEANS AND SEAS

The five great oceans of the world are the Pacific, Atlantic, Indian, Arctic and Antarctic (the last is also called the Southern Ocean).¹

“The great oceans make up somewhat two-thirds of the earth's surface, and our own body contains almost exactly the same proportion of water.”

WILLIAM BEEBE

¹ Approximate areas in millions of square miles : Pacific 68, Atlantic 35, Indian 29, Arctic 5, Antarctic 5.

Among the oceans the Pacific is much the largest. All the land of the world could be placed in it and still leave an expanse of water almost the size of the continent of Africa.

“Only those who have crossed the Pacific Ocean have any real idea of its size—it is said that the moon fell out of it—I can well imagine that it did.”

S. E. G. PONDER

The chief seas of the world are the Gulf of Mexico and Caribbean Sea of Central America ; the Baltic and North Seas of north-western Europe ; the Mediterranean and Black Seas of southern Europe ; the Red Sea, Persian Gulf and Arabian Sea of south-western Asia ; and the Okhotsk, Japan, Yellow and South China Seas of eastern Asia.

Seas.—The lands of the earth do not rise abruptly from the depths of the ocean, but from a platform known as the continental shelf which is really a water-covered continuation of the land. It is on such shelves that the seas are situated.

The continental shelf varies in width in different places. It is only a few miles wide round Africa, along western North and South America, the eastern coasts of India and Japan proper, and off south-eastern Australia ; it is several hundred miles wide off north-western Europe, eastern North America, Eastern Asia and northern Australia ; and it extends from north-eastern Siberia to Alaska without a break.

The continental shelves slope gently from the land to a depth of about 600 feet (100 fathoms), and on them collects the land waste carried by rivers or broken from the coast by the seas, so that the beds of the shelves are very slowly but continually rising. Slight alterations caused by the rising or sinking of continents owing to earth disturbances, or by the increase or decrease of the amount of water in oceans owing to the melting or formation of glaciers on land, have caused and can still cause new seas to appear or old ones to disappear. For instance, if the floor of the North Sea were upraised 600 feet, the British Isles would be joined to the mainland of Europe, and this part of the continent would once more appear as it did before an early earth disturbance gave it its present features.

The sea beds, that is the floors of the continental shelves, are not level, but broken by mountains, hills and valleys. The upper parts of the mountains and hills stand out of the water and form the islands.

Oceans.—At the outermost edge of the continental shelves there is a sudden and abrupt drop to a depth of from 6,000 to 10,000 feet, and this marks the proper “boundary” of the oceans. From this edge the ocean floors flatten out for many miles, their level monotony only in certain parts being interrupted by volcanic peaks and depressions.

About 60 depressions in the oceans have been charted, the greatest being the Swire’s Deep¹, which has a depth of about 35,450 feet : Mount Everest could very easily be drowned in it.

Submarines descend to depths of about 200 feet, men with diving apparatus can go down 300 feet, but enclosed in a large metal globe called the bathysphere, people have descended and stayed for some hours at depths of several thousands of feet.

On the ocean floors, that is at depths of 6,000 feet or more, no land waste is found, but only claylike mud of various colours and kinds known as *abyssal ooze*. As none of this ooze has been discovered among land rocks, it seems that the deep ocean floors are permanent, that is they are not affected by earth disturbances that cause land areas and continental shelves to sink or rise and thus make or unmake seas.

“The sounding tube was emptied of the sample of the bottom which it had sucked up. Under the microscope the greyish-white ooze resolved itself into the fragile shells of infinitesimal creatures.”

WILLIAM BEEBE*

The foregoing facts about oceans enable us to distinguish them from seas by their larger size, greater depth, permanence, and absence of land waste. Also while thousands of sea islands are the tops of submerged mountains which are generally continuations of land ranges, the oceanic islands have no connection whatever with the relief of land, for they are either of volcanic origin or of coral formation.

¹ To the east of the Philippine Islands in the Pacific Ocean.

SALINITY.—The water of all seas and oceans is saline. This is obvious to us from its taste, and also because we can swim in it more easily than in fresh water ; salts cause water to be more dense and therefore salt water buoys up bodies better than fresh water.

Salts are carried to the seas by rivers. Although river water is “ fresh ” or “ sweet ” and drinkable, nevertheless it contains minute quantities of mineral salts collected from the rocks and soils among which it flows. The seas have received these very small amounts of salts from thousands of rivers for millions of years. Another factor contributing to their salinity is the evaporation of their surface waters by the heat of the sun ; only pure water changes into vapour, and the salts being constantly left behind cause the remaining water in the course of time to become more and more saline. The salts of some minerals (calcium, etc.) are used by sea creatures for building up their bodies, and so gradually common salt has come to predominate in sea water, hence its taste.

Some scientists have said that the age of the earth can be calculated by measuring the amount of salt in sea water. But others hold the view that not all the salt has been derived from rivers, a portion having entered the sea at its beginning direct from the magma, for it is a fact that salt is often erupted with lava from volcanoes.

Sea water is not everywhere equally saline. Where large rivers or melting glaciers enter it, and where there is much rain and little evaporation, the water is less saline ; where rivers are few, rainfall scanty and evaporation great, the water is more saline. Thus the Baltic Sea, which receives many rivers, has heavy rainfall and is too cold for much evaporation, contains almost fresh water ; whereas the Mediterranean Sea with comparatively few rivers, little rain and a hot sun causing constant evaporation, has rather bitter salt water.

TEMPERATURE.—The surface waters of the seas and oceans have temperatures almost similar to the lands in their neighbour-

hood. But as water absorbs heat and cold more slowly than land, the seas are always cooler in summer and warmer in winter than land.¹

The waters in equatorial latitudes have temperatures always about 80° F., those in polar regions are icy cold, and where the temperatures are lower than 28° F., the waters freeze into ice-sheets and blocks, which are separated by channels of warmer water moved there by winds and currents.²

But it is only surface waters whose temperatures vary in different latitudes. The strength of the heat from the sun decreases gradually the lower it penetrates into water, until at 1,000 feet below the surface of the ocean the sun's rays (both light and heat) have no effect at all. Below this level the temperature everywhere is the same, round about 29° F. Scientists have found that even at the North Pole this was the temperature of the water 6,000 to 14,000 feet down.

MOVEMENTS.—Seas are never still, because their waters are easily affected by outside forces, which cause the three movements known as waves, currents and tides.

Waves on the sea and the swell of the ocean are merely undulations in the surface of the water ; the water itself scarcely moves backwards or forwards with the waves, but only rises up and down. This is why we sometimes see a boat, a piece of wood, a bottle or a cork bob up and down for hours on the sea without coming nearer the shore.

¹ After a number of hot days when the weather changes and becomes cold, it will be noticed that the water from the tap or in a swimming bath continues to be warm for a little longer. Similarly after a number of cold days when the weather becomes hot, the water remains cool for some time longer. The length of time depends on the amount of water : one to three days for water from the tap (according to the size of the main pipe), two to four days for large swimming baths, and months in the case of those huge reservoirs we call seas and oceans. By the end of summer the seas get warmed and retain some of the heat throughout the winter, at the end of which they become cooled, and keep cool till the end of the summer, and so on.

² The freezing point of fresh water is 32° F., of salt water 28° F.



Courtesy of the Canadian Pacific
WAVES ON LAKE SUPERIOR (page 113)



Courtesy of the Chilean Consulate
THE TIDE COMING IN AT CARTAGENA (page 117)

Waves are due mainly to the wind, and vary in height from a few inches on a calm day to many feet in windy weather. Waves of over 60 feet have been recorded as breaking on the coast, but in the open sea, even in the worst weather, waves are rarely higher than 20 feet.

"Why the Pacific Ocean should be so called passes my comprehension. The whole vast stretch of water was a series of accentuated corrugations, up which we struggled and down which we ran."

S. E. G. PONDER

Currents are great circulatory movements of the waters in seas and oceans, strong enough to carry a ship along with them.

"The Humboldt Current carried us along and enabled us to make from 30 to 40 miles a day more than ever before."

JULIUS FLEISCHMANN

The water level in hot areas is constantly lowered owing to continuous evaporation, and that of cold regions is raised because of the melting of glaciers and icebergs and lack of evaporation, and so there is always a flow of cold water from the polar regions into the tropics. At the same time since warm water (like warm air) is light, the warm surface waters in the tropics get pushed aside by colder heavier water welling up from below, and thus there is also a constant flow of warm water from the tropics to the polar regions. These flowing streams of water in the oceans are called currents.

The currents however do not flow due north and south. Their directions are affected by the earth's rotation, which causes them to be deflected to the east in the northern hemisphere and to the west in the southern hemisphere; by the shape of the ocean basins and coasts round which they swirl; and most important of all, by the prevailing winds which drive the waters before them as they blow. The chief ocean currents have been named and their courses charted.

In the North Atlantic Ocean a warm current, the *Gulf Stream*, flows from the Gulf of Mexico along the eastern coast of North America. Off Newfoundland it divides into two. One branch, the *North Atlantic Drift*, goes across to north-western Europe and

Iceland, bringing warmth to these shores. The other branch, the *Canaries Current*, flows southwards as a cool current¹ towards the equator, on the way washing the shores of the Canary Islands and north-west Africa. Two cold currents flow from the Arctic Ocean into the North Atlantic. One, the *Labrador Current*, merges with the Gulf stream near Newfoundland, the mingling of the cold and warm waters causing the frequent fogs of this area. The other, the *Greenland Current*, flows past the eastern shores of that country and merges with the waters of the North Atlantic Drift. In the South Atlantic the cold *Benguela Current* from the Antarctic Ocean sweeps past the coast of south-west Africa, becomes warm as it reaches equatorial latitudes, and skirts the east coast of South America as the warm *Brazil Current*.

In the North Pacific Ocean a warm current, the *Kuro Siwo*, flows from the neighbourhood of the Philippine Islands northward past the east coast of Japan, and then across to the coast of Oregon in the western United States. The current then divides, one branch going north and warming the coastal regions of British Columbia and Alaska, and the other flowing to the tropics, on the way skirting the Californian coast as a cool current.² From the Arctic Ocean a cold current, the *Kamchatka* (called also *Kurile* or *Oya Siwo*), sweeps through the Bering Strait past eastern Siberia, then along the western coasts of Japan, and on to equatorial waters. In the South Pacific the cold *Humboldt* or *Peruvian Current* flows from the Antarctic Ocean northward past the west coast of South America; by the time it passes the shores of Peru it has become warmed; it then sweeps westward across the central Pacific as the *South Equatorial Current*, and then southward past the east coast of Australia and round the shores of New Zealand as the warm *East Australian Current*.

In the southern Indian Ocean a cold current from the Antarctic Ocean sends one branch flowing north-eastward towards the

¹ Since by now the temperature of its waters, though still higher than the land temperatures of Great Britain, Norway and Iceland, is colder than those of sub-tropical areas.

² Because the temperature of its waters is now lower than that of the land.

south coast of Australia, and another branch northward past the west coast of Australia. The latter, the *West Australian Current*, becomes warm when it reaches tropical latitudes and sweeps across the Indian Ocean, and then goes southwards as the warm *Mozambique Current* past the shores of East Africa and Madagascar. In the northern part of this ocean the currents form two great swirls round the Arabian Sea and Bay of Bengal, but reverse the direction of the flow according to the prevailing winds, flowing round from east to west in the season of the south-west monsoon winds (July), and from west to east at the time of the north-east monsoon winds (December).

Tides.—A person on the seashore finds that the sea daily advances and retreats across the sands from a few inches to many feet. This is known as the tide, which “comes in” and “goes out” twice every 24 hours. Near a landing stage or quay-side boats are seen every day to be raised at high tide and lowered at ebb tide.

The strength of tides varies in different parts of the world. The world’s strongest tides occur in the Bay of Fundy (eastern Canada), where the sea rushes into a funnel-like inlet and its waters pile up, causing a difference of 50 feet or more between high and low water. The world’s weakest tides are experienced in the Mediterranean Sea, where there is practically no change at all in the daily water level; this is because the Mediterranean is almost landlocked, the Strait of Gibraltar being not only narrow but also nowhere deeper than 600 feet, which allows comparatively little advance or retreat of water.

Tides are caused by the gravitational pull of the moon, and to a lesser degree that of the sun. We have seen that all bodies exert this influence on each other (p. 20); water is more affected than land because of its less stable nature, and we can notice best the effect of gravitation on the oceans owing to their vast size.

The moon slightly pulls both earth and water in its direction. This causes the water nearest the moon to pile up in a heap or tidal wave, and as the earth is pulled, the water at the opposite

side of it, from which it recedes slightly, also piles up into a wave. At the same time the earth rotates on its axis, turning from underneath these waves, which therefore are experienced successively by each part of its water surface. To us, however, who cannot feel the earth's movements, it appears that the waves travel round the earth, causing two high tides every complete rotation (24 hours).¹

When the sun is either in line with or opposite the moon (that is at new moon or full moon), its force is exerted in conjunction with that of the moon, and the tides are at their highest. These are called spring tides. When the sun is not in line with the moon (at the moon's 1st and 3rd quarters), its force works against that of the moon, and so tides are at their lowest. These are called neap tides.

LIFE IN THE SEAS AND OCEANS

PLANT LIFE.—Tiny floating plants, sometimes described as sea "grass", live in the surface waters of all seas and oceans. They can exist up to a depth of 150 feet ; farther down there is only animal life.

"All over the watery surface of the globe, even in the middle of the greatest oceans, there is this upper layer of water that teems with green productive life, called the plankton. It constitutes the main food supply of the sea. In certain spots, at certain times, the crop of plant plankton is so dense that it discolours the sea over large patches. But for the most part the plantlets remain invisible and unsuspected until tow-net and microscope are brought to bear." H. G. WELLS, JULIAN HUXLEY, G. P. WELLS

"The luminosity or phosphorescence of the sea in some parts is a remarkable sight and can generally be seen to the best advantage in a gale. It is caused by some forms of plankton and pre-

¹ The moon travels round the earth in the same direction as the earth rotates, and therefore by the time the earth has rotated from one tidal wave to the next, the moon has also advanced in the same direction and with it the tidal waves, so that the opposite wave is not experienced exactly 12 hours after the first, but 12 hours and 25 minutes after, which causes the high tide to get "later" every day.

sents a magnificent spectacle. The crest of each wave as it breaks on the rocks sparkles brilliantly and appears like a sheet of molten silver."

S. B. MILES

LIFE IN SHALLOW WATERS.—Sea creatures live both in shallow and deep waters, but those most used by man are found usually just off the shore, or where undersea hill ranges form "banks" that almost reach the surface, or in shallow seas.

Fish form a very valuable food, whether eaten fresh, salted or tinned, and great quantities are consumed every year by peoples of all lands. A certain amount of fishing is done along every strip of coast, but there are particular areas very rich in fish, and these are all situated in temperate latitudes. The four chief fishing grounds of the world are :

(a) the seas of north-western and western Europe where cod, herring, haddock and mackerel are caught in the open waters, and oysters, plaice, sole and sardines inshore ;

(b) the waters off north-eastern North America and Newfoundland, noted for cod, haddock, herring, tunny, oysters, crab and lobster ;

(c) the coastal waters of north-western North America (from Oregon to Alaska), where the chief fish are salmon, cod, halibut and bonito ;

(d) the seas around Japan, where quantities of herring, haddock, salmon, bonito, crab and lobster are obtained.

Other less important grounds are those of the western Mediterranean, around the coasts of south-east Australia and New Zealand, and off the shores of the Cape of Good Hope (South Africa).

Some kinds of fish and sea creatures useful to man are found only in tropical and sub-tropical waters.

Turtles provide the tortoise-shell of commerce and their flesh makes a rich variety of soup. They are caught in northern Australia and especially in the Galapagos Islands that belong to Chile.

"Three species are very abundant : the green or edible turtle,



A FISHING VILLAGE (p. 119)

the hawksbill or tortoise-shell turtle, and the loggerhead. The loggerhead is the largest of the three and may attain a weight of 1,500 lbs. It lives on fish and shell-fish. The hawksbill turtle never attains a weight exceeding 300 lbs. It has been much hunted for its shell. The green turtle has been hunted for its flesh, which is as tender as young veal and resembles it somewhat in flavour ; it also yields a rich soup."

T. C. ROUGHLEY

Squids, a species of small octopus, are found in most tropical waters, and their flesh is thought a delicacy by many people.

"The water-colour pigment known as sepia is obtained from certain species of squid, the dried contents of the ink-bags being dissolved in dilute ammonia and precipitated with hydrochloric acid."

T. C. ROUGHLEY

The *bêche-de-mer* of north Australian waters is another strange creature esteemed as a dainty by some people.

"We watched the divers going down to the floor of the lagoon for *bêche-de-mer*, or sea slugs. These things look like nothing more than big fat worms the size of a large sausage."

IRVING JOHNSON

Sponges are colonies of minute sea animals, obtained mainly from the Mediterranean off Tunisia and Libya and in the Ægean Sea, and in the Gulf of Mexico off the shores of Florida and the Bahamas Islands.

"The sponges are black and slimy during life and are securely anchored to shells, rocks or other solid objects. The divers of the Ægean are world famous for their skill and endurance. The diver has a life line attached to his right arm, and thus equipped leaps overside with a 30 lb. block of marble, which bears him to the sea-bed 12 to 40 fathoms below. Here he stays for about two minutes, filling a basket at lightning speed, when he is hauled to the surface, his marble 'sinker' attached to another line being recovered separately. The sponges are stamped upon and beaten and then hung overside for 24 hours to remove the last of the slimy substance. There follows more beating, more washings, and finally a period of drying in the hot sun, the sponges being hung on lines."

E. G. BOULENGER



Courtesy of Australian Trade Publications
TROPICAL FISH (page 125)



Courtesy of the Agent General for Western Australia
PLATE IN SHELL (page 120)

The seas also have their precious and semi-precious stones : pearls, mother-of-pearl and coral.

Pearls are found in oysters and result from a piece of grit or sand entering the shell, and the oyster covering it with the same pearly secretion with which it lines its shell. Any oyster may chance to contain a pearl, but the largest and most beautiful are obtained from those of tropical waters. The chief pearl fisheries of the world are in the Persian Gulf.¹

“ It may be said that the pearling industry forms the support of the Arabs on the western shore of the Persian Gulf ; the number of boats employed has been variously estimated at from 3,000 to 5,000, and the number of men at from 27,000 to 40,000. The richest banks are in the proximity of the Islands of Bahrain, which send 2,500 boats to the fishery. The divers descend by means of a heavy stone attached to a rope and begin at once to collect the oysters and put them in a bag, basket or net, suspended from the waist or neck ; they are able to pick up from eight to fifteen oysters, and on jerking the rope are hauled up to the boat. As soon as the boat is full of oysters the captain sails to a sandy islet where the oysters are exposed in the sun until they rot, when the pearls are gathered from the shell.”

S. B. MILES

“ Many of the divers are brought up unconscious, and cannot often be brought to life. Deafness, caused by the enormous pressure of the water at such depths, is common among divers. Rheumatism and neuralgia are universal, and the pearl-fishers are the great exception among the Arabs in not possessing beautiful teeth. On the shore the pearls are classified by the merchants, according to weight, shape, colour and brilliancy. There are button-pearls, pendants, roundish, oval, flat, and perfect pearls ; pearls white, yellow, golden, pink, blue, azure, green, grey, dull and black ; seed-pearls the size of grains of

¹ Other pearling grounds are : the Red Sea (southern half), off Ceylon (the Tinnevely coast, Maanar Gulf and Palk Strait), Hainan (east of Indo-China), Sulu Islands (southern Philippine Islands), Aru Islands (west of New Guinea), the northern and north-western coasts of Australia, New Hebrides, Lower California, Gulf of Panama, Margarita Island (Venezuela).

sand. I have seen a pendant-pearl the size of a hazelnut, worth a few thousand rupces. Colour has only a fashion-value, Europe prefers white and the Orient the golden-yellow ; black pearls are not highly esteemed by Orientals." SAMUEL M. ZWEMER

Mother-of-pearl is the shell-lining of a type of non-edible mussel or oyster. It is obtained from waters where oysters are found, but is most abundant off the north Australian coast.

"The pearl-shell is the Great Barrier Reef's richest treasure. The rich mother-of-pearl is an important article of commerce for conversion into buttons, sleeve-links, knife-handles, trinkets. Not only are these pearling grounds the most extensive in the world, but the shell is easily the largest of all pearl-shells."

T. C. ROUGHLEY

Coral is composed of colonies of coral polyps. Red, white and pink coral are obtained in the waters near south-western Italy and made into beads and ornaments. In more tropical regions the polyps are so numerous that instead of their skeletons providing necklaces and jewellery, they offer man stretches of "land" on which to live. In the central Pacific Ocean, in the waters of north-eastern Australia,¹ in the Gulf of Mexico, in the Caribbean Sea, and in one case (the Bermuda Islands) in the northern Atlantic Ocean, the coral polyps have built up great reefs and islands.²

"Whoever approaches Tahiti from the north passes between a crowd of coral islets, each of which is a ring or sometimes a sort of horseshoe of grass and low shrubs scarcely rising above high-water mark, and enclosing a smooth lagoon. Some are tiny, some a mile or more in circumference. Some have a surface

¹ The Great Barrier Reef stretches almost from the coast of the island of New Guinea to Sandy Cape in eastern Australia. With a length of about 1,250 miles and an area of 80,000 square miles, it is the largest coral formation in the world.

² Coral needs water with an average temperature of 70° F. in order to live and multiply, and therefore it is found only in the tropics, except in the case of the Bermudas where the water has a high temperature owing to the Gulf Stream.

only a few yards wide, others are broader and higher, with soil enough to support rows of coconut palms. Islands of this type are called Atolls—a word drawn from the name they bear in the Maldivé Archipelago—and their shape has usually been explained by supposing them to have been built up along the edges of a submarine volcanic crater, the rest of which is filled by the lagoon. Most of these atolls are uninhabited, but those large enough to have plenty of coconuts and perhaps other fruit-bearing trees, can support a certain population, who live off the fruit and the crustaceans they find on the reef, and the fish they catch in the lagoon ; and by collecting the mother-of-pearl shells and selling the coconuts for copra to any trading ship that comes their way. Strange and picturesque are these little specks of islands in the vast ocean.”

VISCOUNT BRYCE

LIFE IN DEEP WATERS.—The majority of sea creatures live in shallow seas, but some prefer the deep ocean. Many of the ocean creatures dwell in its surface waters, some are equally at home near the surface or deep below, others live part of the time in the ocean and part of the time on land, yet others remain always in the ocean depths.

Flying-fish exist in reality and are not a sea tale. Chased by *dolphins* and *porpoises* they take to the air, and as soon as their little wings dry, they dip in the water to wet them and then fly again.

“ One of the first denizens of deep water, and one of the most interesting, that we saw as soon as we got down to warmer latitudes were flying-fish. Just a few at first, then shoals and shoals of them. They simply swarm all over the tropic seas. Their so-called wings are thin gauzy affairs, bearing no resemblance to those of a bird but more like a huge dragon-fly’s. Their flight is really no more than skimming ; they rise out of the water with a flip of their tails and vibrate their wings like planes. A couple of hundred yards is about their limit, then back they fall into the water with a ‘ zip ’ and, a moment after, leap out again and are off on another flight.”

REX CLEMENTS

Whales are the largest living creatures, some of them being over 80 feet long. They come to the surface to feed on "meadows" of plankton, then dive to tremendous depths. They are hunted by man for their oil and whalebone. An interesting substance obtained from them is ambergris, used in making high-grade perfumes. It is a fatty matter derived from the stomachs of certain kinds of whales that feed on cuttlefish, and consists mostly of the undigested horny beaks of this creature. Ambergris is very rarely found, and so it is one of the expensive articles of commerce; it costs about £5 an ounce.

"Off the Canary Islands I saw up to half a score of huge black bodies heave themselves silently half out of the sea. As they rose, thin jets of watery vapour were thrown high in the air with a long hissing noise. They seemed in no hurry, but with an easy gliding roll that hardly rippled the water went curving under. A moment or two later up they came again, then down once more they plunged. They were most fascinating to watch, in movements so vast and leisurely, yet they did not ruffle the surface so much as a swimming man would have done." REX CLEMENTS

"The Antarctic Ocean may be described as the great banqueting hall of the whale, for it provides a superabundance of suitable food. This consists of myriads of small shrimps, which live at some depth below the sea surface." A. G. BENNETT

Sea-cows, known also as *dugongs* and *manatees*, are interesting miniature relatives of the whale. They live in tropical waters, and it is thought that they were the creatures which gave rise to the ancient belief in mermaids, for a dugong can hold itself erect in the water, and the female occasionally cradles its young in its arms, appearing almost human when viewed from a distance.

Sea-lions live for part of the time in water and part on land, choosing the smaller and often unpeopled islands for their homes.

"I saw several of these vast sea-lions, some of them were upward of 16 feet long, and more in bulk, so that they could not weigh less than a ton. The shape of their body differs little from the sea-dogs or seals, but they have another sort of skin, a head much bigger in proportion, and very large mouths, monstrous



Courtesy of the Agent General for Queensland
 CORAL REEFS (page 121)



Courtesy of the High Commissioner for New Zealand
 A YOUNG WHALE (page 126)

big eyes, and a face like that of a lion, with very large whiskers, the hair of which is stiff enough to make tooth-pickers. I admire how these monsters come to yield such a quantity of oil. Their hair is short and coarse, and their skin thicker than the thickest ox-hide I ever saw."

WOODES ROGERS

Seals like sea-lions live partly in water and partly on land. They frequent the colder waters in or near polar regions, their chief haunts being the Pribilof Islands of the North Pacific. In the last century they were so extensively hunted for their fur (sealskin) that their number diminished considerably and it was feared they might become extinct ; now they are protected by international agreement.

"The seal is an excellent swimmer and diver, and to obtain its food, which consists chiefly of fish, it sometimes descends to extraordinary depths. It can also jump out of the water on to a floe the edge of which lies as much as six feet above the surface. I have often seen them shoot suddenly out of the sea, describe a curve in the air, and plump down some way inside the edge of an ice-floe high above the water."

FRIDTJOF NANSEN*

The *walrus* is akin to the seal except that it possesses long tusks. It also is an amphibian and lives in polar regions, and is hunted by eskimos.

The oceans contain many other kinds of fish of different shapes and sizes, from 4 inch sea-horses to 40 feet sharks. Sharks are commercially utilised, for their skins are manufactured into leather goods, and soup made with their dried fins is esteemed as a dainty by the Chinese. Sea-horses are but one among a great variety of tiny fish beautiful in colouring and movement.

Among the oceanic fish there are many that live permanently below depths of over 150 feet. These therefore cannot subsist on plankton, but obtain their food partly by preying on each other and especially from the countless corpses that are continually sinking down, the creatures killed in the upper levels of the water. Some of these deep-water fish are phosphorescent.

"The darkness in the depths is complete, save for what light is generated by their living inhabitants. Water rapidly cuts off

light. Most of the fixed bottom-living forms shine all over, often with a marvellous radiance. Sometimes there is a single row of small lights down the body ; sometimes tiers of lights, so that the fish looks like a liner at night."

H. G. WELLS, JULIAN HUXLEY, G. P. WELLS

The following is a description of what was seen in the depths by the first scientist who descended several thousand feet in a bathysphere to make observations :

"The outside world I now saw through my window was a solid, blue-black world, one which seemed born of a single vibration—blue, blue, for ever and for ever blue. I looked out and watched an occasional passing light. Each light is an individual thing, often under direct control of the owner. A gigantic fish could tear past the window and if unilluminated might never be seen. My eyes became so dark-adapted at these depths that there was no possibility of error ; the jet blackness of the water was broken only by sparks and flashes and steadily glowing lamps, varied in colour and of infinite variety as regards size and juxtaposition. It leaves the mind in a maze of wonder—to think of having seen these hidden multitudes, many most delicate and fragile, avoiding their enemies and searching for food, all amid black ice-cold water with nearly a half-ton of weight crushing down upon every inch."

WILLIAM BEEBE

RIVERS

Rivers carry to the lakes, seas and oceans most of the water that falls as rain and snow on the land surface of the globe.

"Rivers perhaps are the only physical features of the world that are at their best from the air. Mountain ranges, no longer seen in profile, dwarf to anthills ; seas lose their horizons ; lakes have no longer depth but look like bright pennies on the earth's surface ; forests become a thin impermanent film, a moss on the top of a wet stone, easily rubbed off. But rivers, which from the ground one usually sees in cross sections, like a small sample of

ribbon—rivers stretch out serenely ahead as far as the eye can reach. From the air rivers are seen in their true stature. They tumble down mountain-sides ; they meander through flat farm lands. Valleys trail them ; cities ride them ; farms cling to them ; roads and railroad tracks run after them—and they remain, permanent, possessive. Next to them, man's gleaming cement roads which he has built with such care look fragile as paper streamers thrown over the hills, easily blown away. But rivers have carved their way over the earth's surface for centuries and they will stay."

ANNE MORROW LINDBERGH

The source or beginning of every river is due to water or snow falling on sloping ground. Rain that falls on non-porous rocks (such as granite) runs off in little streamlets down gullies or hollows among the rocks, and groups of these streams on their way unite with one another, and thus if the rainfall is sufficient and constant, a permanent rivulet is born. When rain falls on porous rocks (such as sandstone), the water soaks into the ground, and sinks down until it reaches and is stopped by a layer of non-porous rock, where it is stored up as "ground water". If there is frequent rain the porous rock gets saturated, and if the ground water is present in flat country, wells can be dug which will never go dry, as in parts of Arabia ; if the ground water is stored up in a depression, when wells are sunk the water is forced upwards by pressure, forming the artesian wells common in many parts of Australia ; but if the ground water is present in a hilly area, the water will escape as a spring and drain away as a brook. Very many rivers and their tributaries (among them most of those of Great Britain) begin in one of these ways—from rain running off non-porous rocks and from springs.

If rain falls on clayey soil or in a hollow among impervious rocks, it will form a swamp or lake, and if the rainfall is fairly continuous, the excess water will drain from the swamp or lake as a rivulet. Some of the world's greatest rivers have such an origin : the Mississippi of North America, the Amazon of South America, the Nile of Africa, the Yenesei of Asia.

Snow falling on mountains sometimes gives rise to a glacier or

river of ice, which flows slowly downhill until it reaches lower levels, where it melts. Many famous rivers have their sources in glaciers : the Ganges of India, the Rhine of Germany, the Rhône of France.

“ When you get near the Rhône Glacier, you find it consists of a series of huge blue-white jagged teeth of ice frozen absolutely solid and over 300 yards wide ; its blueness is peculiar. It is fascinating to see how the drips from the glacier become a trickle a few inches wide ; then how the trickle becomes a rivulet two or three feet across ; how this becomes a brook which you can still step over ; how this brook becomes a stream six yards across—all within a mile from the Glacier.”

CHARLES GRAVES

The upper course of a river is usually among highlands. The stream, increasing in size as it is joined by other brooks, rushes swiftly downhill dashing over boulders and rocks, and often forming rapids and waterfalls. Here it is useless for navigation, but it can be utilised for turning water-mills or generating hydro-electric power.

Sometimes the entire course of a river is set through mountainous country, as that of the Salween River in Indo-China. Such rivers are occasionally called “ young ”, for generally rivers flow over uneven country at the beginning of their lives, and gradually their waters wear away the rocks and thus flatten out and widen their beds.

The middle course of a river begins when it leaves the highlands for the plains. It flows more slowly on flat ground, meandering round obstacles instead of hurtling over them, winding in great curves through the country. These curves in time get more pronounced, for the current (caused by the river flowing from the hills) wears back the outside bank ; and when the curves become great loops with narrow necks, the river breaks across these to straighten its course, so that the loops remain as “ lakes ” beside the river. This is the origin of the “ ox-bow lakes ” beside the Mississippi River of the United States. Rivers flowing through flat country are navigable, and much use is made of them for transport, especially of heavy goods.

In its middle course a river is often joined by others, known as its tributaries or affluents. The River Amazon receives over 1,000 tributaries while it flows across the selvas of South America.

"The forest through which we progressed was cut by numerous streams. Some flowed down across the trail, and we forded them. Some dropped sheer upon it from rocky shelves above, and we ducked them. Others we could see coursing through the valleys below. And still others we could not see at all, but heard incessantly as they gurgled in the deep recesses of the vegetation. They flowed in every direction of the compass. But their destinations were all the same. However far astray they might go, their waters would eventually find the Amazon and the Atlantic Ocean."

JAMES RAMSEY ULLMAN

The mouth of a river is the place where it empties its waters into a sea or lake. Many great rivers, among them the Mississippi, the Amazon, the Nile, the Volga and the Ganges, carry much silt which they deposit at their mouths, and in the course of time the deposits form large areas of land (known as deltas), through which the rivers flow in a number of channels.¹ When ports are situated near the mouth of a delta-forming river, as New Orleans on the Mississippi, there has to be constant dredging to keep the port open for shipping. Other rivers have their silt washed away by tides and piled up in the water near-by to form "bars" or sand-banks.

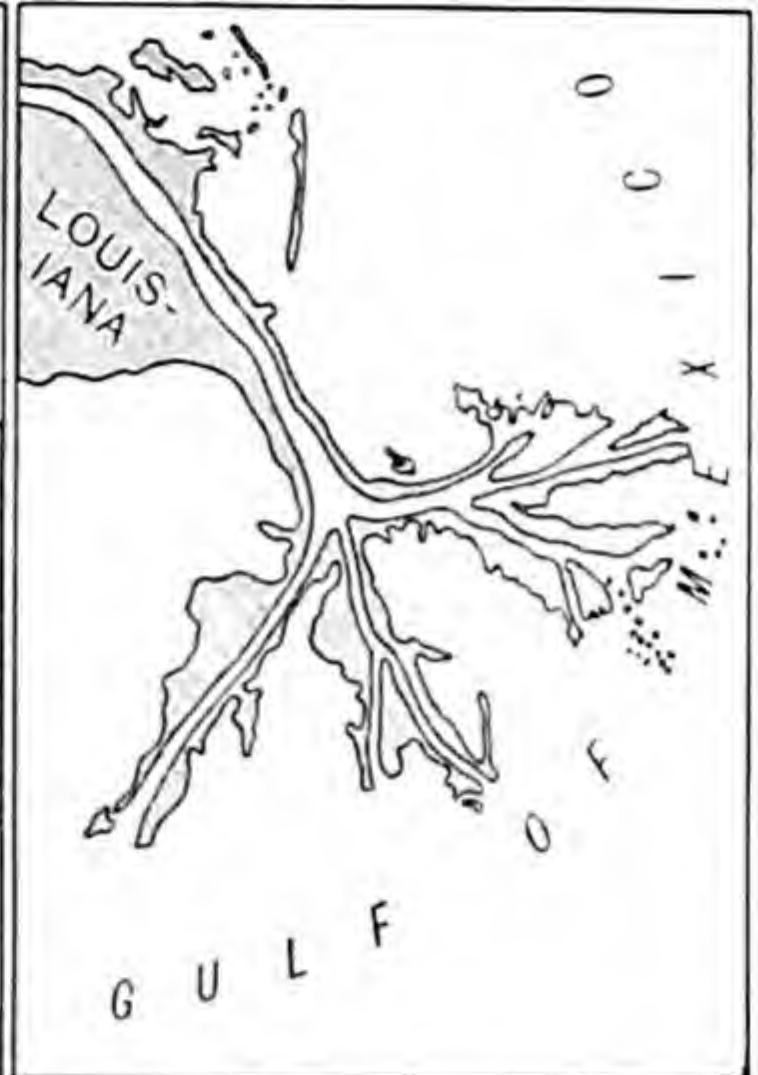
In some cases, owing to the sinking of the land, or rising of the sea, the lower valley of a river has been drowned, so that it admits the tides for some distance. The mouths of tidal rivers are known as estuaries. The tides carry away most of the silt brought by such rivers, and this prevents the formation of deltas or bars. Examples of this type of river-mouths are those of the Thames and Mersey in England, and the Clyde and Forth in Scotland.

Since the water of rivers is derived from rain and snow, the

¹ As the silt-made land at the mouth of the Nile, when looked at from the north, resembles in shape the Greek letter Δ (*delta*), the ancient Greeks called it the Delta. This name is now universally applied, although not all silt-made land is this shape.



THE NILE DELTA



THE MISSISSIPPI DELTA



NEAR MANAOS

Courtesy of the Booth Steamship Company, Ltd.

1,000 MILES UP THE RIVER AMAZON (page 135)

depth and width of a river usually depends on the amount of water it receives from the atmosphere. In lands where the rain varies very much at different seasons of the year, the rivers are at one period great torrents and at another period tiny streams.

“The rivers rising in internal India rush through wide beds in the rainy season and drop to the merest trickle in the dry months.”

SIR GEORGE MACMUNN

“In winter the River Vaal of South Africa trickles apologetically among great, black, shiny, defiant stones ; and in summer, swollen by rains in the Transvaal, it rushes down in a thundering wall of water. It runs through the lands of diamonds and gold and platinum. In the very bed of it there are diamonds. Its water is drunk in three provinces.”

S. G. MILLIN

“Anyone unaccustomed to the ways of streams in countries of heavy rains would be surprised at the increase which sometimes takes place in the volume of a river like the Cauca of Colombia in an exceedingly short space of time.”

EUGÈNE ANDRÉ

THE GREAT RIVERS OF THE WORLD.—There are 25 rivers in the world with a length of more than 1,500 miles, that is they would stretch farther than from Paris to Moscow. Of these, 10 are in Asia, 5 in North America, 4 in Africa, 3 in South America, 2 in Europe, and 1 in Australia.

The Great Rivers of North America.—The world's longest river is the Mississippi (4,200 miles) in North America ; it is long enough to stretch from London to Delhi. Together with its great tributaries the Missouri, Arkansas, Red, Ohio and Tennessee, it drains the whole of the Central Plains of the United States, offering over 15,000 miles of navigable waterways, and forming a great delta where it enters the Gulf of Mexico.

“Out of Itasca Lake the ‘Father of Waters’ flows with a breadth of about 12 feet, and a depth ordinarily of less than 2 feet. It goes at first northerly, and then makes a grand curve through a long chain of lakes, and takes its south-east course towards the Falls of St. Anthony, and onward in its progress to the Gulf.”

JOEL COOK

The River St. Lawrence of Canada is smaller in size, being only about 2,000 miles long if the River St. Louis which enters the western end of Lake Superior is counted as its headstream. Commercially, however, the St. Lawrence is as important as the Mississippi, for it drains the Great Lakes and forms a wide and deep water-highway leading from the centre of the continent to the Atlantic Ocean. It carries a tremendous amount of shipping during the seven or eight months in the year it is open to navigation ; in winter it is frozen.

The other three long rivers of North America are the Mackenzie (2,350 miles) of Canada, which flows from the Rockies to the Arctic Ocean ; the Yukon (2,200 miles) of Alaska ; and the Colorado (1,700 miles) of the western United States, which runs through the famous Grand Canyon and enters the Gulf of California. The Mackenzie and Yukon are closed by ice for four or five months in the winter.

The Great Rivers of South America.—The second longest, but the widest, river in the world is the Amazon (4,000 miles) of South America, which rises in the little Lake Lauricocha near Cerro de Pasco (Peru). Its chief tributaries are the Madeira, Xingu, Tocantins, Yapura and Rio Negro. It is navigable by ocean steamers for 1,000 miles from its mouth, and by smaller river steamers for 2,000 miles.

The River Orinoco (1,500 miles) rises in the Guiana Highlands, on its way is joined by several tributaries from the northern Andes Mountains, and flows into the Atlantic Ocean. Its waters mingle, through a natural canal, with those of its great neighbour, the Amazon.¹

“ Shortly before we sailed an interesting newcomer pulled into port : a small launch flying the Venezuelan flag that had come to Manaos not by way of the Amazon, but through the Casi-

¹ When two neighbouring rivers, like the Orinoco and the Amazon, flow in the same direction, sometimes one or several of the tributaries of one river merge into tributaries of the other river, and then in due time the waters of both are drawn off by the stronger (*i.e.*, more swiftly running) river. This is known as river capture.

quiare Canal and down the Rio Negro. This natural canal, the only one of its kind in the world, connects one of the tributaries of the Negro with the Upper Orinoco in southernmost Venezuela, thus providing a continuous inland waterway from the Caribbean Sea to Manaus and the heart of Amazonia. More than 200 miles in length, it is broad and deep enough during the rainy season to accommodate ships of considerable draught, but the region it serves is so remote and commercially undeveloped that only a handful of boats traverse it in a year."

JAMES RAMSEY ULLMAN

The third great river of South America is the Rio de la Plata or Plate River. It receives the waters of the Parana River (2,000 miles) from southern Brazil and Paraguay; of the Paraguay River, (1,500 miles) from southern Brazil and central Paraguay; of the latter river's tributary the Pilcomayo River from Bolivia; and of the Uruguay River (1,000 miles) from the republic of that name. The Rio de la Plata flows to the Atlantic through an estuary 200 miles long, and is about 100 miles wide where it enters the ocean.

The Great Rivers of Africa.—The world's third longest river is the Nile (3,600 miles) of Africa, which rises in Lake Victoria in the East African Plateau, and forms a large delta at its mouth in Lower Egypt. Its chief tributary is the Blue Nile from Lake Tana in Ethiopia, which in the wet season receives so much water from monsoon rains that it causes the annual flooding on which depends the prosperity of the Sudan and Egypt.

"The Nile, in its course through the narrow and winding valley of Upper Egypt, which is confined on each side by mountainous and sandy deserts, is everywhere bordered, except in a very few places, by cultivated fields of its own formation. They are interspersed with palm-groves and villages, and intersected by numerous canals."

EDWARD WILLIAM LANE

"The Nile passes through many lands. There are the irrigated areas of the Delta and Lower Egypt, and the vast deserts of Upper Egypt. Then across the little-known sandy wastes of Lower Nubia and the Sudan, and, still farther south, through the

40,000 square miles of the great Sudd, or Central African swamp. Below this amazing region lie the jungles of the southern Sudan and of Uganda."

CHARLES DOMVILLE-FIFE

Another important African river is the Congo (3,000 miles). Its headstream, the Chambezi, rises in East Africa immediately to the south of Lake Tanganyika. The river flows westwards across the continent, and after being joined by many tributaries, enters the Atlantic Ocean near the equator.

"For purely tropical scenes, I commend the verdurously rich isles in mid-Congo. There the rich verdure reflects the brightness of the intense sunshine in glistening velvet sheen from frond and leaf. Some of the smallest islets seemed to be all aflame with crimson colouring."

SIR HENRY STANLEY

The River Niger (2,600 miles) rises in the Futa Jallon Highlands of West Africa and enters the Gulf of Guinea.

"All the way in the lower course there is a full range of tropical landscape. At some places the forest comes to the edge of the water. Where a stretch of sand lines the shore, crocodiles are frequently seen at rest. Standing quite alone are the riverside villages, enveloped on three sides by the forest."

J. R. RAPHAEL

The fourth great African river, the Zambezi, rises in Angola, and after being joined by tributaries from Northern Rhodesia, Southern Rhodesia and Lake Nyasa, flows through Portuguese East Africa into the Indian Ocean.

"The river is, indeed, a magnificent one, often more than a mile broad, and adorned with many islands of from 3 to 5 miles in length. Both islands and banks are covered with forest. The beauty of the scenery is greatly increased by the palm with its gracefully curved fronds and refreshing light-green colour."

DAVID LIVINGSTONE

The Great Rivers of Asia.—Asia contains ten of the world's greatest rivers, among which are the 4th, 5th and 6th longest. This continent is unique in the fact that eight rivers, each with a length of over 1,000 miles, rise in one highland area,¹ and flow

¹ The rivers are the Indus, Ganges, Brahmaputra, Irrawaddy, Salween, Mekong, Yangtse-kiang, Hwang-ho, all of which rise in the Tibetan Plateau.

thence to such widely separated seas as the Yellow Sea, South China Sea, Bay of Bengal and Arabian Sea ; five of these rivers leave the highland by means of gorges only a few miles apart from each other.¹

Asia's longest river is the Yangtse-kiang (3,400 miles), which flows from Tibet eastwards across Central China, and forms a great delta where it enters the Pacific Ocean.

"The Yangtse-kiang, the Great Muddy River of China, is one of the greatest rivers, and its valley the most densely populated and closely cultivated river basin of the globe. Rising in northern Tibet on the Roof of the World, this 'Girdle of China' crosses the whole country in its 3,000 mile course to the sea, touching nine of the richest provinces, draining and giving communication through a region more than 600 miles wide, a basin of 600,000 square miles, with a population estimated at 180 millions."

ELIZA RUHAMAH SCIDMORE

The Yenesei (3,200 miles) rises in Lake Baikal and flows northward across the Siberian Plain to the Arctic Ocean.

"The Yenesei claims respect on account of its size. At Krasnoyarsk, which is 1,700 miles from the sea, where we first saw the Yenesei, its banks are a thousand yards apart ; farther north the river widens to over a mile, and eventually broadens, at its mouth, to the amazing width of 100 miles."

DOUGLAS CARRUTHERS

The Lena (3,000 miles) rises in the Lake Baikal Mountains, and the Ob (3,000 miles) in the Altai Mountains, and both flow northwards, like the Yenesei, over the Siberian Plain to the Arctic Ocean.

The Amur (2,800 miles) rises in Mongolia and flows eastwards through the U.S.S.R. to the Pacific Ocean. It is joined by the Sungari which, with its tributaries, drains the central plains of Manchukuo.

The Hwang-ho (2,700 miles) rises in eastern Tibet and flows through northern China into the Yellow Sea. The Mekong

¹ The five rivers are the Brahmaputra, Irrawaddy, Salween, Mekong, and Yangtse-kiang.

(2,600 miles) rises in south-eastern Tibet and flows southwards, through south-western China and French Indo-China, into the South China Sea.

The Indus (1,900 miles) rises in western Tibet and flows southwards to the Arabian Sea. It is joined by the Kabul River from Afghanistan, and by the Panchnad River which receives the combined waters of five rivers from the Punjab.¹

“The Indus flows first westward through the wonderfully beautiful state of Kashmir, and then turns south-west into the important province of the Punjab. The very name Punjab means ‘Land of the Five Rivers’.”

LADY HARTOG

The Brahmaputra (1,800 miles) has its source in south-western Tibet, through which country it flows as the Tsang-po for 800 miles. It then passes through a gorge in the Himalaya and flows across north-eastern India, entering the Bay of Bengal through the Ganges delta.

The Ganges (1,500 miles) has its source near those of the Indus and the Brahmaputra, breaks through the Himalaya near Hardwar, and flows across the Great Plain of India in a south-easterly direction. It is joined by the Jumna, the Gogra and the Son rivers, and in its great delta by the River Brahmaputra.

“The waters of the two great rivers spread out into innumerable channels. Between the two largest estuaries of the Ganges delta, the Megna on the east, and the Hooghly on the west, there is a distance of nearly 200 miles.”

LADY HARTOG

Two important rivers in western Asia, though not as long as those mentioned, are the Euphrates (1,200 miles) and the Tigris (900 miles). They rise in the Armenian Highlands of Asia Minor, flow southwards in almost parallel courses until they unite, and their combined waters continue the journey as the Shatt al-Arab for another 100 miles till they reach the Persian Gulf.

The Great Rivers of Europe.—Europe’s longest river is the Volga (2,200 miles) in Russia, which rises in the Valdai Hills and flows to the Caspian Sea.

¹ The five rivers are the Jhelum, Chenab, Ravi, Bias and Sutlej.

" This mighty artery of the Russian plain, with its tributaries, waters most of the Russian Soviet Republic west of the Urals—a plain of nearly 1,459,000 square kilometres, or more than Germany and France taken together. This area, with over 150 million inhabitants, was before the war of 1914–18 Europe's granary. The Volga is the source of well-being for the people in the whole of south-west Russia ; along it and its tributaries (in summer) you can go by boat right up to the Ural Mountains in the east, through canals to the Polar Sea in the north and to the Baltic in the north-west, and when the Don Canal is finished, to the Black Sea and the Mediterranean in the south-west."

FRIDTJOF NANSEN

The Danube (1,750 miles) is the second largest river in Europe. Rising in the Black Forest it flows eastwards to the Black Sea, on the way passing through six countries and receiving tributaries from each : the Inn and March from southern Germany, the Waag from Slovakia, the Drava, Sava and Morava from Jugoslavia, the Tisa from Hungary, the Isker from Bulgaria, the Sereth and Pruth from Rumania.

" The Danube winds on mile after mile, through country flat or mountainous, striking in majesty, or dull and uninspiring, yet always retains its placid character as the outlet for national enterprise and the main road of the Balkans."

J. R. COLVILLE

The Longest River of Australia.—Australia's greatest river, the Murray, rises in the Australian Alps, flows westwards until it is joined by the Murrumbidgee and the Darling, and then sweeps southwards to the Southern Ocean.

" With its principal tributaries, the Darling and the Murrumbidgee, the navigable length of the Murray in flood seasons would reach from Lisbon to Leningrad—2,286 miles. Usually it is at its highest from August to November. There are, unfortunately, times when the Murray and its tributaries become little better than a succession of stagnant water holes. In the droughts of 1902, 1914 and 1922, the Murray itself ceased to flow."

SYDNEY UPTON

Some Small Rivers.—There are many very important rivers which

are too short to include in this account of the world's greatest rivers. Foremost among them is the Rhine (760 miles) of Europe, the most highly developed commercial waterway in the world. It has its source in the St. Gotthard Glacier of Switzerland, and after flowing through that country, continues through Germany (forming for part of its course the German-French frontier), and then goes through Holland and enters the North Sea. Other noteworthy examples of small but important rivers are the Thames of England, the Seine and Rhône of France, the Elbe of Germany, the Po of Italy, the Fraser of western Canada, the Hudson and Columbia of the United States.

The Importance of Rivers.—Rivers are useful to man in many ways. They drain away excess water from the countryside, often abound with fish,¹ provide cheap and easy means of communication, cut gaps penetrating mountain ranges, give their water for homes, factories and farms, can be used for the disposal of waste and sewage, and, where there are falls or rapids, offer means of generating hydro-electricity. Such advantages have caused the building of most of the great cities of the world on or near rivers. But rivers also have their disadvantages: expensive bridges have to be constructed in cities to allow heavy traffic to cross them, and their occasional floods cause much damage.

LAKES

A lake is an area of water in the midst of land. Some lakes are the remnants of former seas (for example, the Caspian); some are due to a river being dammed by a moraine, a stream of lava or landslide (those of the Lake District in England); some are formed from river "loops" (the ox-bow lakes in the United States); some are made up by water collecting in hollows scooped out by glaciers (alpine lakes), in cracks formed by movements of

¹ The chief fresh-water fish are whitefish, trout, pickerel, eel, salmon and sturgeon (caviare is sturgeon's roe). Crocodiles and alligators frequent rivers and lakes of tropical lands, and the hippopotamus or river-horse haunts those of Africa.

the earth's crust (rift valley lakes), in deep craters left on the summits of extinct volcanoes (crater lakes), and in hollows on the earth's surface (depression lakes).

Many lakes receive water from streams and rivers which drain into them, and a great number get rid of their surplus water by giving birth to rivers.

The majority of lakes contain fresh water ; but where there is much evaporation and comparatively little incoming water, they have become salt lakes.

Lakes are of all sizes, from Lake Windermere of England with an area of six square miles to the Caspian Sea which is about twice as big as Great Britain. The world contains 14 lakes as large or larger than Wales (7,000 square miles), of which 6 are in North America, 4 in Africa, 3 in Asia, and 1 in Europe.

The world's largest fresh-water lake, Lake Superior, is in North America. It is about as big as Scotland (31,200 square miles), and is one of a group of five lakes known as the Great Lakes,¹ all of which are drained by the River St. Lawrence. The other noteworthy lakes of this continent are all in Canada : Great Bear Lake, Great Slave Lake and Lake Winnipeg.

The largest African lake, and the third biggest in the world, is Lake Victoria or Victoria Nyanza, situated in a depression on the East African Plateau. Steamers ply "round the lake" cruises, taking a week to complete its circuit. It is only slightly smaller than Lake Superior. Other large lakes in Africa are Tanganyika, Nyasa and Albert, all in the Great Rift Valley that cuts through the East African Plateau.

The largest lake in the world is the Caspian Sea on the boundary between Asia and Europe : it is a salt lake 170,000 square miles in area.

" There it lay, stretching away towards the horizon, a glorious blue under the fresh breeze in the morning's sunshine. There was no essential difference to be seen between this, the world's greatest inland sea, and the sea in general—anyhow, at first sight.

¹ The five lakes are Lakes Superior, Michigan, Huron, Erie and Ontario. The first three of these are bigger than Wales.

True, the shore had no mark of ebb and flow, as we know them ; but then there is none in the Mediterranean or the Black Sea."

FRIDTJOF NANSEN

The Aral Sea of Asia, in the south of the U.S.S.R., is the fourth largest lake in the world. It receives two important rivers, the Amu Darya and the Syr Darya, which flow from the highlands of Central Asia across the plains of Turkistan. Another great Asian lake is Lake Baikal, situated also in the U.S.S.R. ; it has a depth of over 4,000 feet, and is the world's deepest lake.

Europe's largest lake, Ladoga, is in the west of the U.S.S.R. It is as large as Wales.

Among the highest lakes in the world are Lake Tana (7,500 feet altitude), the source of the River Blue Nile in Ethiopia ; the Tibetan shallow salt Koko Nor (10,500 feet altitude) ; and the highest of all, Lake Titicaca (12,000 feet altitude), among the Andes Mountains of South America, on the boundary between Peru and Bolivia.

" Lake Titicaca has no counterpart in all the world. As large as the Straits of Dover, it is both the highest and most beautiful of inland seas. At the little Bolivian port of Guaqui, some two and a half miles above the sea, the great blue expanse of Titicaca bursts suddenly into view ; a sunlit ocean in a cradle of distant, shadowy, snow-covered mountains. No more curious sensation can well be imagined than that created by the waves and the thousand-ton passenger liner awaiting to embark passengers at the top of the Andes."

CHARLES DOMVILLE-FIFE*

Several lakes are situated below sea-level. The surface of the Caspian is 86 feet below, that of the Salton Sea of the United States 247 feet below, and that of the Dead Sea of Palestine 1,292 feet below sea-level. This last is the lowest lake in the world.

" The waters of the Dead Sea are wonderfully clear and blue, but so salt and bitter that no fish is found in them."

A. J. REYNOLDS

Lakes are, like rivers, useful to man for their fish (those that contain them), for domestic and industrial use, for irrigation, and

as means of communication. In addition, salt lakes provide salts of various kinds. Common salt is obtained from those of Africa, Asia and the western United States, epsom salts from inlets of the Caspian Sea, soda and borax from those of Tibet, magnesium and potassium salts from the Dead Sea.

WATERFALLS

The force of falling water can make steel turbines revolve and thus generate hydro-electric power. Electricity can be employed on the spot or transported by cables distances of several hundred miles, and used for lighting, heating, and the running of machinery. Certain processes, such as the refining of aluminium from bauxite and the obtaining of nitrogen from the air to make fertilisers, are possible only where there is abundant electric power. Electricity is sometimes known as "white coal" owing to its smokelessness and cleanliness, and is gradually replacing the mineral fuels coal and oil. Unlike these, the stores of which will in time be exhausted, running water renews itself and provides a permanent supply of power.

Great progress has been made in certain areas (North America, northern Italy and Norway, for example) in the development of water power. In places where the waterfalls occur in sparsely peopled districts remote from industrial cities (as in many parts of Africa), measures have not yet been taken to harness their power, but in the future these may become of great commercial value.

North America is very rich in waterfalls, and also contains one of the two greatest falls in the world. This is Niagara, situated on the River St. Lawrence, between Lakes Erie and Ontario. The river here is nearly a mile wide and the water drops 175 feet. Goat Island on the brink of the falls divides them into two stretches : the Canadian or Horseshoe Falls 3,000 feet wide, the American 1,060 feet wide.

" There are two Niagaras : the largest and most beautiful is,



Courtesy of the High Commissioner for Southern Rhodesia
THE VICTORIA FALLS (page 146)



Courtesy of the Canadian Pacific
A HYDRO-ELECTRIC POWER STATION (page 144)

however, the famous Horseshoe Falls on the Canadian bank—the international frontier actually passes through this spectacular region—and then there are the American Falls divided from the other by a spit of land formed of rock and forest.”

CHARLES DOMVILLE-FIFE

There are hundreds of falls in Canada : among the Rockies and the Coast Ranges of British Columbia, the Laurentian Highlands of Ontario and Quebec, and in Labrador, where the chief one, the Grand Falls of the River Hamilton, drops 1,300 feet with a width of 150 feet. There are as many falls in the United States : among the Appalachians of the east and the Rockies and Coast Ranges of the west. The Great Yosemite Waterfall of the Sierra Nevada in California is famed for its beauty ; it consists of three slender successive falls, the highest of which drops 1,612 feet. The chief waterfall in Mexico is the Tecalutla, where the Necaxa River drops 1,600 feet in a succession of falls, and provides electric power for Mexico City.

South America contains numerous waterfalls. On the Iguazu River, a tributary of the River Parana, there are over 150 waterfalls, some with drops of 250 feet, presenting a gorgeous spectacle. In the Brazilian Highlands are the Paulo Affonso Falls, where the River São Francisco (60 feet wide) drops first 70 and then 192 feet ; these are the only South American falls used for generating power. There are many falls in the Guiana Highlands, where the main ones are the lofty George VI, Edward VIII and the Kaieteur Falls (all in British Guiana), with drops of about 1,200, 800 and 740 feet respectively.

The continent of Africa consists mainly of great plateaus of varying altitudes, and therefore all the rivers are interrupted by falls and rapids as they leave the higher levels of the interior for the coastlands. The Victoria Falls of the Zambezi River (in Central Africa) are as imposing as the Niagaras. They are, like Niagara, divided into two by an island ; one stretch has a width of 1,719 feet and the other 975 feet ; the waters of the river fall 350 feet. The 19th-century discoverer of this great waterfall described his first view of it in the following way :

“Creeping with awe to the verge, I peered down into a large rent which had been made from bank to bank of the broad Zambezi, and saw that a stream of a thousand yards broad leaped down a hundred feet, and then became suddenly compressed into a space of fifteen to twenty yards. In looking down the fissure one sees nothing but a dense white cloud, which, at the time we visited the spot, had two bright rainbows on it. From this cloud rushed up a great jet of vapour exactly like steam, and it mounted 200 or 300 feet high ; and came back in a constant shower which soon wetted us to the skin. A few yards back from the lip, there stands a straight hedge of evergreen trees, whose leaves are always wet.”

DAVID LIVINGSTONE

There are other noteworthy waterfalls in Africa. On the River Congo are the Stanley Falls, where for a stretch of 56 miles the river dashes over a series of 50 cataracts. The waters of the Nile, before entering Lake Albert, fall 100 feet at the Murchison Falls ; while the Blue Nile, just after it leaves Lake Tana in Ethiopia, drops 150 feet at the Tisisat Falls ; and the combined streams fall 800 feet in a series of six cataracts situated between Khartoum and Aswan. The Aughrabies of the Orange River in South Africa consist of a series of falls with a total drop of 2,810 feet, the greatest single fall being 400 feet. This river varies greatly as to the amount of water it carries ; in flood-time the falls are a stupendous sight, for the river is very deep and about 60 feet wide, but during the rest of the year the river and its falls decline to a mere trickle. There are a number of other waterfalls in South Africa (in the Drakensberg Mountains), in Mozambique, the Belgian Congo, Angola and Ethiopia.

Asia, despite its many large rivers and lofty mountain ranges, is not rich in great waterfalls, for the rivers leave the highlands by means of a series of low falls or rapids in their deep gorges. For example, the River Brahmaputra flows across the Tibetan Plateau at an altitude of 12,000 feet, and later reappears at sea-level on the plain of India ; yet the only discovery to account for this tremendous drop has been the Rainbow Falls of south-eastern Tibet, and these are only 40 feet high ; the Tibetans say

that there are 75 other such falls in the as yet uncharted gorge by which the river breaks through the Himalaya. The biggest waterfalls of Asia are the Khon Cataracts of Indo-China, where the River Mekong, 3,000 feet wide, drops over several falls, the highest being 70 feet. The Indian state of Mysore contains two important waterfalls, but these vary in their amount of water according to whether they are viewed in the rainy or dry season ; they are the Gersoppa Falls of the Sharavah River, with a drop of 829 feet and a width (during the monsoon rains) of 801 feet, and the Swasamudram Falls of the Cauvery River, where the river divides into two branches, one 692 feet wide and the other 580 feet, and drops 182 feet ; this latter waterfall is used to generate hydro-electric power. There are also a series of cataracts in the upper Yangtse-kiang, and many slender waterfalls in the mountainous interior of Japan, where the Kegon Falls are noteworthy, with a drop of 250 feet.

Europe has many waterfalls, but all are slender, except the Shaffhausen Falls of the Rhine, which are 380 feet broad but have a drop of only 60 feet. Waterfalls are numerous in Norway, Switzerland, southern Germany and northern Italy, and great use is made of them for obtaining power. Iceland possesses, however, Europe's greatest waterfalls, Dettifoss and Gullfoss, both of which are wide and drop 190 and 164 feet respectively.

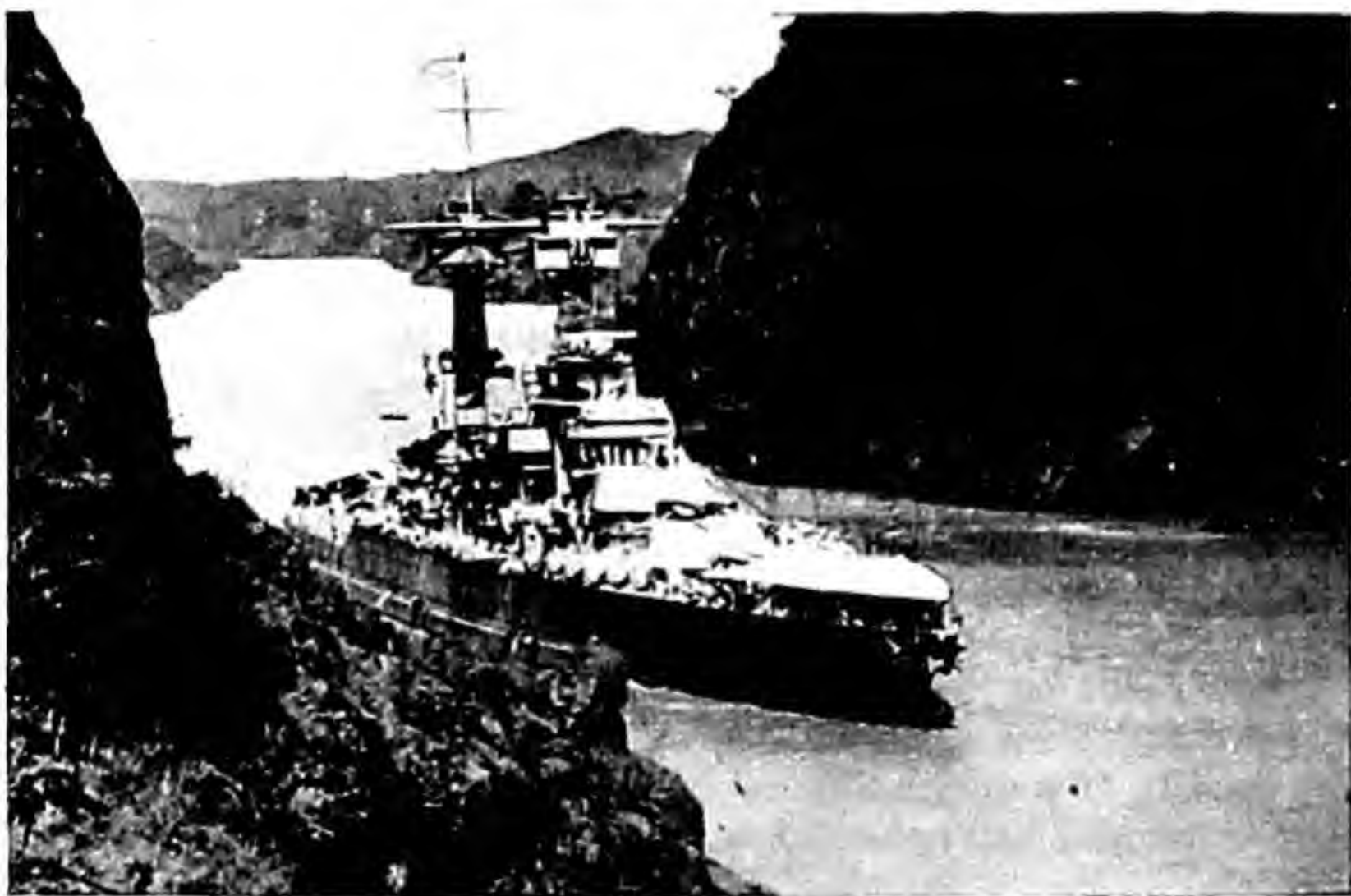
Australia has several slender falls among the eastern highlands. The greatest are the Barron Falls near Cairns, which drop 600 feet, and the Tully Falls near Ravenshoe, which fall 1,000 feet in two drops. The waterfalls of New Zealand are also slender, though this country has one of the world's highest, the Sutherland Falls, which have a total drop of 1,904 feet in three successive leaps.

CANALS

Canals are rivers made by man. The two greatest are the Suez Canal of Egypt, connecting the Red Sea and the Mediterranean, and the Panama Canal of Central America, connecting the



Courtesy of P. & O. Steam Navigation Company
THE SUEZ CANAL (page 148)



Courtesy of Messrs. Elders & Fyffes, Ltd.
THE PANAMA CANAL (page 148)

Atlantic and Pacific Oceans. These were constructed in the late nineteenth and early twentieth centuries in order to shorten the sea journeys between continents and countries. By using the Suez Canal the journey round Africa is saved when travelling by sea between western Europe and southern Asia. The Panama Canal makes possible sea journeys between eastern and western North America without going round South America.

Many canals are built to join rivers and make through boat-traffic possible. Central Europe contains networks of hundreds of miles of canals joining all the rivers, the Rhine with the Rhône, the Danube with the Rhine, etc.

Sometimes canals are dug to avoid waterfalls or rapids. The Welland Canal of the River St. Lawrence circumvents the Niagara Falls. Other canals are made in order to connect an inland city with the sea ; for example Manchester, by virtue of the Ship Canal which enters the River Mersey, has become a port. Many thousands of miles of canals in lands where rainfall is scanty or seasonal provide water for irrigation and domestic use ; for instance the Fayum Oasis in Egypt, about 700 square miles in area, owes its existence to the canal (Bahr Yusuf) that connects it with the Nile.

CIRCULATION

The waters of the earth are never still. Not only rivers flow to the seas, seas and oceans are stirred by tides and currents, but all the time the heat of the sun causes evaporation, and from the smallest puddle and the greatest ocean water is sucked up into the sky as invisible vapour, to pile up as clouds, which gradually drop their moisture as rain, snow, sleet or hail, to refill the gaps made by the evaporation. The amount of water or moisture on the earth has never changed ; the " fresh " water of rivers that we now drink has been used by all living beings for millions of years. It is the continuous circulation of water that causes it to be purified and presented as fresh water to every generation.

EXERCISES

1. Explain shortly why salt water is saline.
2. Write a brief account of the causes and effects of the main hot and cold ocean currents.
3. Why are waterfalls of commercial importance to a country? Give examples of some that are already made use of.
4. Write short notes on : continental shelf, Swire's Deep, abyssal ooze, waves, swell, spring tide, mother-of-pearl, ambergris, coral.
5. Rewrite, filling in the missing words :

Water covers nearly — — of the surface of the globe. The land is fringed by —, and beyond these extend the five great oceans, the —, —, —, — and — oceans. The sea is never still ; its waters are — by the — to form waves. There is a constant interchange of waters between — and — regions, causing the — and — currents. Owing to the — — of the —, the waters pile up into two tidal waves, and as the earth rotates, coastal regions experience alternately — and — water twice each day. The — supplies us with fish, and there are — very important fishing grounds : the seas of — —, the waters of — — North America, those of — — North America, and the seas around —. The land surface of the world is drained by — and —. The four longest rivers are the — of North America, the Amazon of — —, the — of —, and the — of Asia. The three largest lakes are the — Sea of —, Lake — of — America, and Lake — of Africa. The two greatest waterfalls are — of North — and the — Falls of —.

COMPOSITION

The River's Tale.

LOCAL STUDY

Write an account with sketches of the river, stream, lake or pond nearest your home.

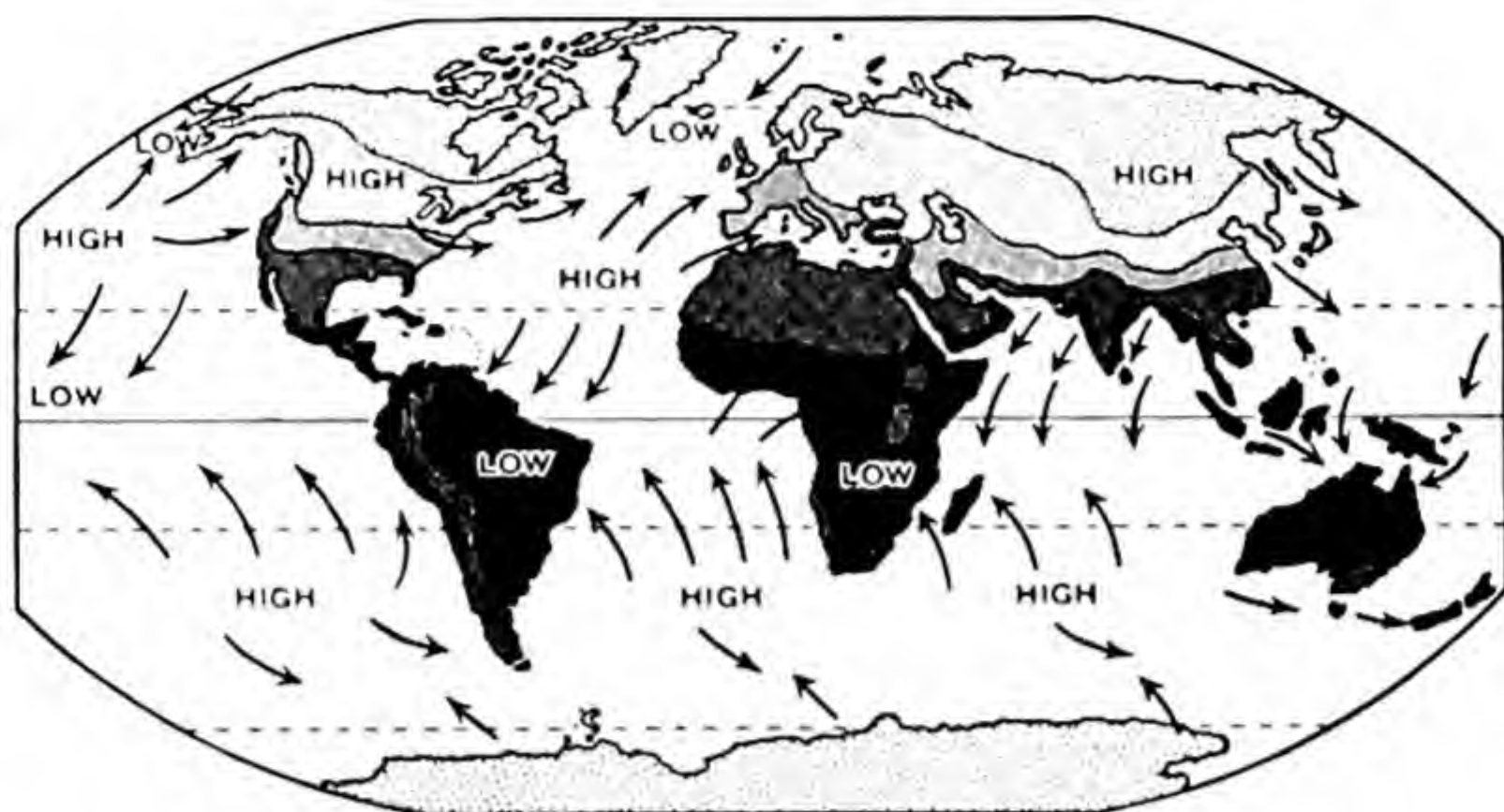
HANDWORK

Model a relief map (in dough made of flour and a pinch of salt mixed with a little water) of any of the continents to show the main mountain ranges, rivers and lakes. When the dough is dry it can be suitably coloured.

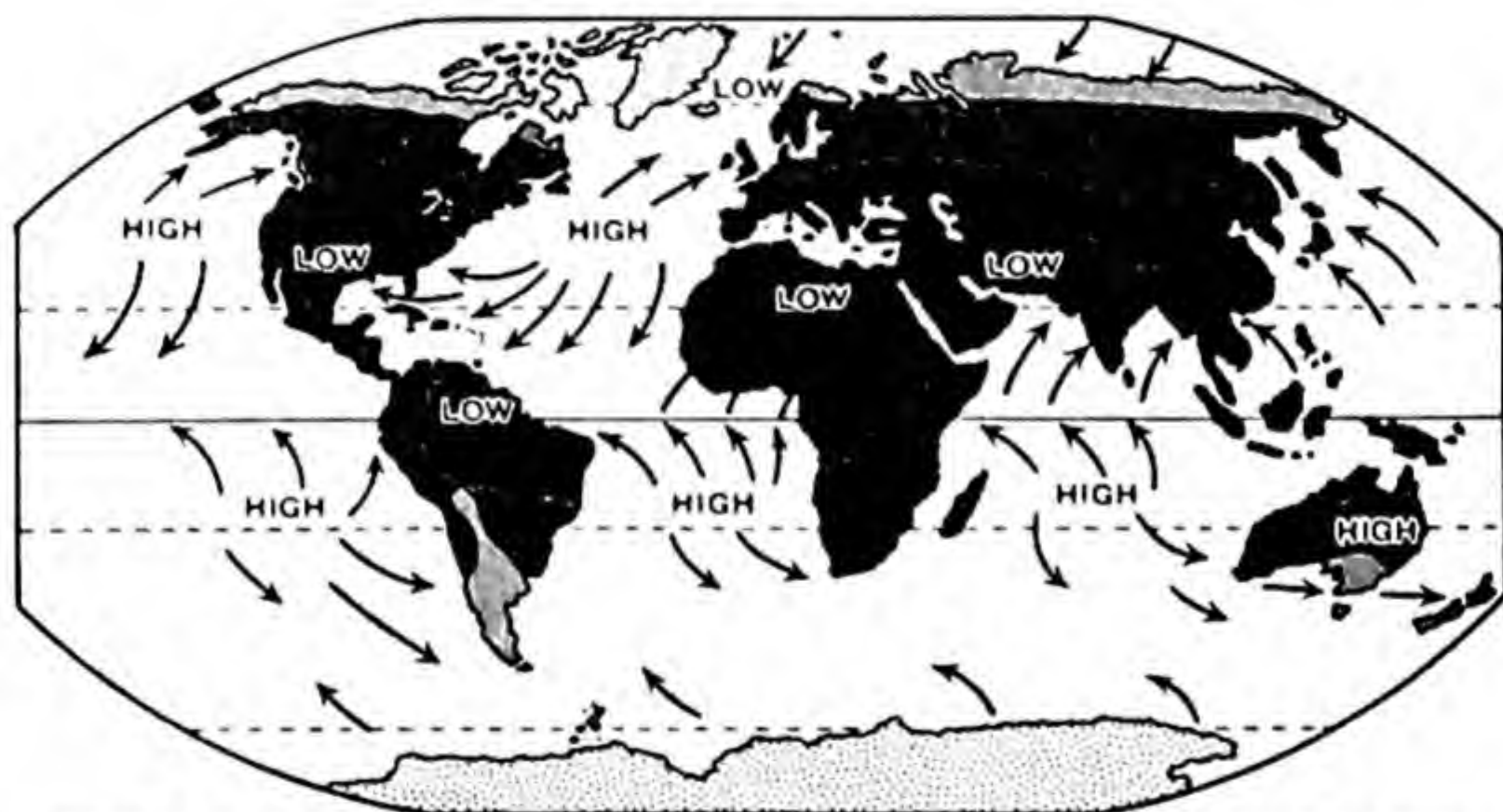
GAME

The name of any river mentioned in this chapter is supplied, and the person who describes most satisfactorily the regions through which it passes, provides the next name of a river.

CHAPTER SIX



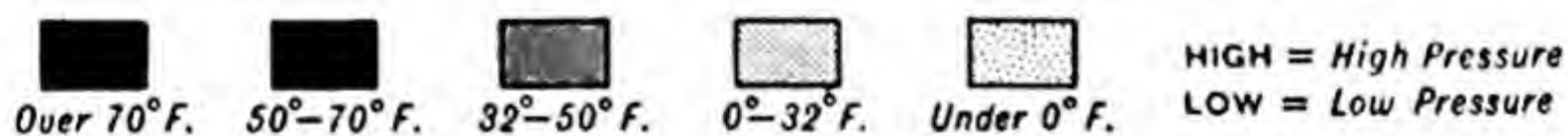
JANUARY



JULY

Emery Walker Ltd. sc.

Denoyer's Semi-elliptical Projection



TEMPERATURES AND PREVAILING WINDS

CHAPTER SIX

AIR

THE ATMOSPHERE.—A zone of air more than 600 miles thick envelops the earth ; it is held to the earth by the force of gravity and rotates with it in space. Air is composed of a mixture of gases, mainly oxygen and nitrogen, but its consistency and qualities are not uniform throughout its thickness round the earth.

The Upper Atmosphere.—We know as yet practically nothing about the outer 400 miles of the atmosphere, except that it is in this region the Aurora Borealis shine and spread their gleaming rays.

Below this belt, that is at a height of just over 200 miles above the earth, extends the Appleton Layer, which like a sounding board reflects back wireless waves to the earth.

The 150 miles-deep layer below the Appleton Layer is believed to be extremely hot, for here the smaller meteors that enter the earth's atmosphere burn up into dust, appearing to us as shooting stars.

Below this, lying about 56 miles above us, is the Heaviside Layer, which also acts as a reflector for wireless waves.

For 50 miles downwards from the Heaviside Layer extends the Stratosphere, which contains air such as we breathe but spread out and very thin or "rare". The lower levels of the stratosphere have been visited by scientists travelling in "stratosphere balloons", and by aeronauts wearing oxygen apparatus and protected by specially constructed suits. American stratonauts collected, at a height of $13\frac{1}{2}$ miles above the earth, six gallons of stratosphere air, and when they regained the earth's surface found that it equalled less than a quart of ordinary air. Owing to this thinness of the air at that height, temperatures in the stratosphere

are low (about -100°F.) ; there are no clouds, because it is too cold for water-vapour to exist ; no dust is carried so high, and so stratonauts see the sun as a brilliant disc in a *black* sky, and the earth spreading as a giant arc below them.

“ At 46,000 feet I looked down, and below me I could see the whole of the English South Coast from Margate to Land’s End, and north almost as far as the Wash. London looked like a toy town, and the Thames a piece of narrow ribbon. Looking south I could see the coast of France. I felt small and lonely, and had the impression that England was a very small space.”

F. R. D. SWAIN¹

The Troposphere.—About 6 or 7 miles above the surface of the earth the stratosphere gives place to the troposphere, the layer of air in which we live and breathe. In its lower levels the air of the troposphere is at its densest, exerting a pressure of 15 lbs. to the square inch, but in its upper levels it is almost as thin and cold as that of the stratosphere, as mountain climbers and aeronauts bear witness.

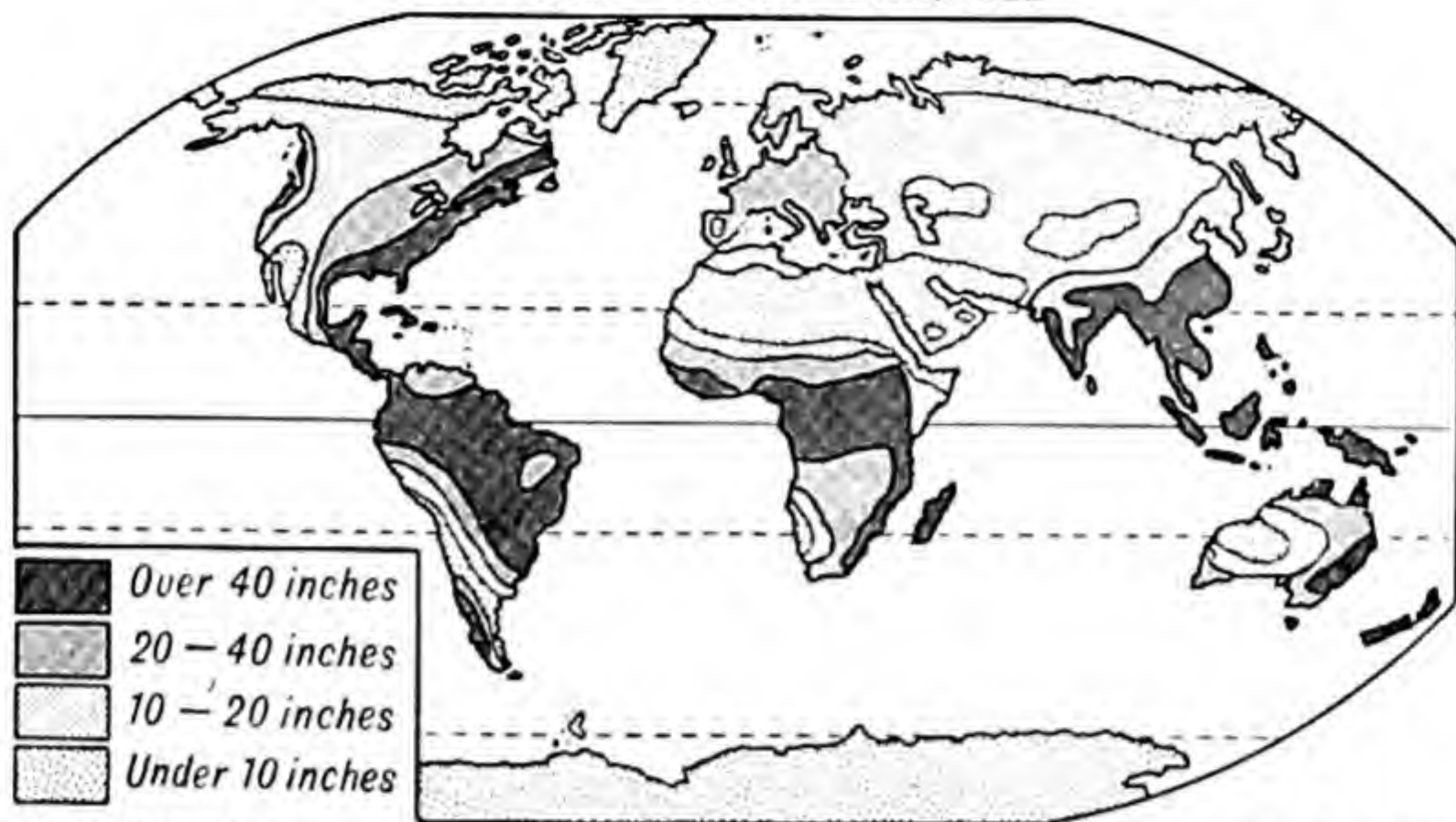
“ Up here on the mountains, under the diminished pressure, water of course boils at a lower temperature ; in consequence of this the potatoes after boiling for some hours were as hard as ever ; the pot was left on the fire all night, but yet the potatoes were not softened.”

CHARLES DARWIN

The troposphere contains, in addition to oxygen and nitrogen, small quantities of carbon dioxide, ozone and other gases, as well as varying amounts of dust and water-vapour. Much of the water-vapour is invisible, the remainder we see as clouds. It is the presence of these extra substances in the air immediately surrounding the earth that causes the light of the sun to be diffused through the atmosphere, the sky to appear blue by day and rainbow-hued at sunset and sunrise, and periods of twilight to be experienced outside the tropics. But by far the most important way the troposphere affects us is the part it plays in determining weather conditions.

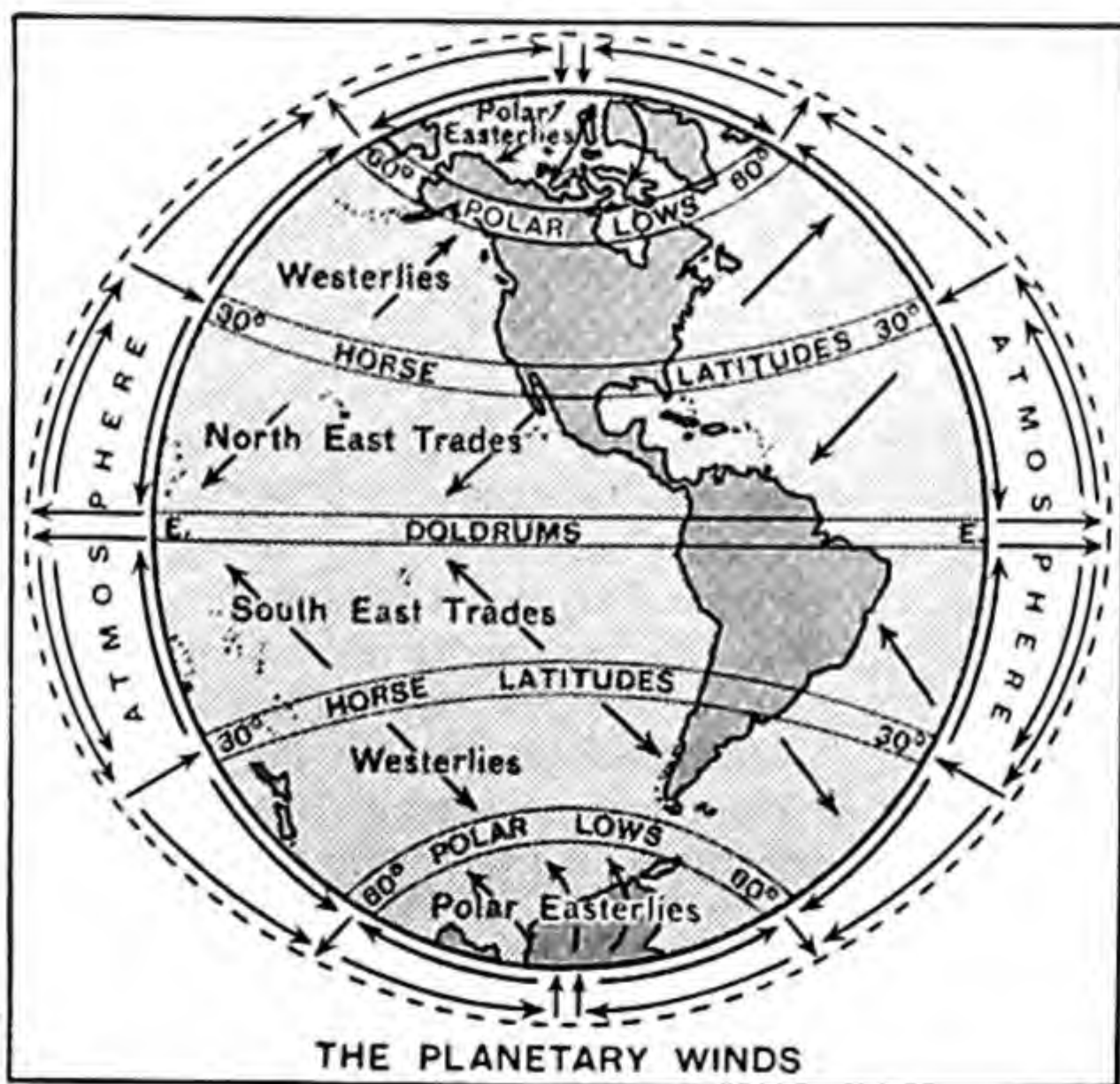
¹ This description was given by Squadron Leader Swain to newspaper reporters on 29th September, 1936.

AVERAGE YEARLY RAINFALL



Emery Walker Ltd. sc.

Denoyer's Semi-elliptical Projection



The weather or climate of a place has more effect on man than anything else. Not only does it influence his personal comfort and habits, but it decides what type of vegetation will grow there, what animals can live there, what kind of food, work and home man must have.

Climate depends firstly on the temperature of the air, and secondly on the amount and kind of precipitation¹ derived from the water-vapour in the atmosphere.

TEMPERATURE is the warmth or coolness of the air, and it is measured by a thermometer. This instrument is a thin tube containing mercury or coloured alcohol, substances quickly affected by cold or heat, which cause them to contract or expand down or up the narrow tube. The tube is marked off in degrees from below the freezing point of water to its boiling point, and from the position of the mercury or alcohol we can tell the temperature of a place. Two main scales are used for the degrees, Fahrenheit and Centigrade, the former being usually employed in England.

It is useful to know a few details from both scales : 32° F. and 0° C. mark freezing point, at 50°–60° F. or 10°–15° C. the weather is mild, at 60°–70° F. or 15°–21° C. it is warm, above 70° F. or 21° C. it is hot, while 212° F. and 100° C. mark the boiling point of water.²

All countries keep records of the temperatures experienced by them, and the average daily temperature is found by taking the mean between the highest and lowest ones recorded during the day. From the average daily temperatures of each month a monthly average is worked out, and from these a yearly one is prepared. These figures are used in making temperature and weather charts, on which lines (called isotherms) are drawn connecting places having the same average temperature. When considering the temperature of a place it is not enough to know

¹ Precipitation is moisture in the form of rain, snow, sleet, hail or dew.

² The two scales can be converted : $F. = \frac{9}{5} C. + 32$; $C. = \frac{5}{9} (F. - 32)$.

only the yearly temperature, for without finding out the range of temperature (that is the difference between the lowest and highest temperatures) a wrong impression may be obtained. For example, the average yearly temperatures of Quito in South America and Kashgar in Central Asia are 55° F., yet at Quito the January and July temperatures are both 55° , while at Kashgar they are 22° and 80° respectively.

Warmth in the Air.—Heat rays from the sun strike land and water surfaces of the earth and warm them, these in turn warm the air above them, and the atmosphere thus becomes heated *from below upwards*.¹ This is partly the reason for the decrease in temperature with altitude, another reason being the thinning of the air according to its height above the earth. The decrease in temperature is about 1° F. for every 300 feet ascended. Thus wherever there are hills and mountains, their higher slopes and summits are always cooler than the lowlands. In equatorial Africa (where the lowlands experience temperatures of over 70° F.) the summit of Mount Kilimanjaro is permanently snow-capped. In India during the summer many people leave the hot plains and visit the cool hill-stations of the Himalaya. In Mexico the bulk of the population live on the temperate interior plateau in preference to the tropical coastlands.

“Leaving the favoured highlands of Yemen for the plains is rather like leaving Switzerland and suddenly finding oneself planted in the middle of the Sahara.”

HANS HELFRITZ

“Although we were near the equator, it was so cold and wet that we wore thick tweeds imagining ourselves on the Scottish moors. The reason for this state of affairs is that Addis Ababa is 8,000 feet above the sea. While there was heavy tropical heat at Jibuti, the nearest port in French Somaliland, in Addis Ababa the climate resembled that of the highlands of Scotland.”

E. W. POLSON NEWMAN

“The day we crossed the Bhyundar Pass in Tibet was wet, cold and miserable. Below 16,000 feet rain was falling, but above

¹ If there were only the atmosphere without the earth, the heat generated by the sun would pass through it and not warm it at all.

that height there was sleet and snow. We descended into the valley. Within a few minutes we were out of the wind and in rain which became gradually warmer as we lost height."

F. S. SMYTHE

Latitude.—Since heat is obtained from the sun, it will obviously vary according to latitude. In tropical regions where the sun is directly or almost directly overhead, the heat will be greater than in the upper latitudes where the sun's rays strike the earth's surface at an angle and each ray spreads over a large area. Moreover, we have seen that during the earth's yearly revolution round the sun, the hours of daylight are practically uniform in the tropics, while varying greatly from summer to winter in the upper latitudes. Thus, as the maps on page 154 show, temperatures in tropical lands change little throughout the year, and those of more northerly or southerly areas have great differences. For instance, Manaus near the equator (in Brazil) has a range of only 3° F. between its highest and lowest temperatures, whereas Dawson in Canada has a January temperature of -23° F. and a July one of 60° F.

Distance from Sea.—The temperature of a place varies also according to its distance from the sea. Water takes in and gives out heat more slowly than land,¹ and therefore places far away from the sea have more extreme temperatures than those near the sea which benefit by its cooling influence in summer and its comparative warmth in winter. Coastlands washed by ocean currents are more markedly affected, for the currents modify the climate of places along which they flow.

"To our surprise it was unusually cold. This amazing weather on the Equator was caused by the Humboldt Current, which originates in the Antarctic regions and flows northward and then westward, cooling everything with which it comes in contact."

JULIUS FLEISCHMANN

"The Arctic coast of Finland is neither so cold nor so dark in winter as you might think. The long and narrow Petsamo Fjord

¹ See the footnote on p. 113.



CLOUDS (page 162)

Courtesy of the Romanian Location



FOG (page 165)

A Kodak Snapshot

is never ice-bound. For it is influenced by the North Cape Stream, a Nordic relative of the Gulf Stream, which not only keeps the harbours ice-free, but also gives the northern heights a milder climate than they would otherwise have."

HARRY A. FRANCK

Clouds.—The atmosphere helps to keep the earth warm, and the clouds act as a blanket, preventing the escape of heat received from the sun ; accordingly night temperatures in cloud-covered areas are often higher than those of cloudless tropical regions.

"It was on this my first real desert experience that I learned how a man can go to bed at night with the mercury ranging up in the nineties, and find ice in his water pitcher next morning."

ROBERT FROTHINGHAM

PRECIPITATION is any form of moisture from the atmosphere falling on land or water. Air obtains moisture (which is present as invisible vapour or clouds) through evaporation, that is through heat causing some of the water on the earth's surface to change into water-vapour. Should the air become cooled the water-vapour condenses and is transformed into water again.

The amount of water-vapour present in the air is known as its *humidity*. This varies in different places : air over oceans and seas is more humid than that over deserts ; air in warm regions, where the great heat causes rapid evaporation, contains more moisture than that of cold latitudes ; and hot air can hold more water-vapour than cold air. The humidity of the air affects the comfort of human beings as much as, if not more than, temperature, because the human body is always giving off heat through evaporation, and this process is retarded in humid air. So we find that people can endure the dry heat of the desert much better than the damp heat of places bordering the sea or marshy lowlands.

"The moist heat in Dutch New Guinea depresses the nerves after a short while, and then one cannot sleep and is never free of headache."

EVELYN CHEESEMAN

Water-vapour and clouds in the air may become cooled in a number of ways : by air rising to colder levels of the atmosphere

on its becoming heated or if it has to cross high mountains, by air from over warm seas moving in over colder land areas, and by currents of cold air blowing into the warmer atmosphere. When any of these things happens, the moisture in the vapour and clouds condenses and falls on the earth.

Rain is the most general form of precipitation. The amount of rain is measured by a rain-gauge in which the rain is collected. Meteorological stations in different countries publish their average monthly and yearly rainfall. On rainfall maps the lines connecting places with equal annual rainfall are called isohyets.

Some places such as Cornwall have all the year rain, others such as India have rain only at certain seasons. In the latter case it is important to know when during the year the rain falls, since on this depends the type of vegetation. For instance, grass needs rain in the spring and early summer, wheat requires dry weather when it is ripening, and so on.

It is also necessary to know the kind of rain that falls. Cyclonic rain is gentle, penetrates into the ground, and sometimes lasts for days; thunderstorm rain falls heavily, runs away rapidly, and lasts only a short time.

“When the heavy rains do start in earnest the water comes down in sheets; the dried-up watercourses become raging torrents, and unmade roads become absolutely impassable.”

E. W. POLSON NEWMAN

“To all travellers who may be tempted to wander through the extreme west of China in spring or in summer, I give the friendly advice: refrain from doing so. This half of the year is the rainy season there, and landslides carry away roads, floods fill valleys, bridges break up.”

ALEXANDRA DAVID-NEEL

In general, places that have a yearly rainfall of less than 10 inches are desert, those with 10 to 20 inches are grassland, those with 20 or more inches forested, but since evaporation is greater in hot regions, more rainfall is required there for the growth of vegetation than in cold lands, where there is little evaporation.

If the water-vapour in the air condenses at temperatures lower than 32° F., it will fall as *snow*. About one foot of snow equals



Courtesy of the "Midland Daily Tribune," Nuneaton
 AFTER VERY HEAVY RAIN (page 163)



SNOW (page 163)

A Kodak Snapshot

one inch of rain, but snow lying on the ground keeps the soil warm and provides all its water for plant life, as it melts slowly and so none is wasted.

Sleet consists of frozen rain-drops and occurs when rain from warmer air passes through colder air as it falls.

Hail occurs mainly during thunderstorms and often in hot weather. It is formed by water-vapour condensing into rain and then being carried into higher and colder layers of air, where the raindrops freeze before falling. Sometimes the frozen drops are carried even higher, and obtain a second, third or fourth coating of ice, and fall as very large hailstones which often do much damage to plant and even animal and human life.

Fog or mist is merely a cloud at ground level. *Dew*, which occurs at night, is caused by cool air condensing the water-vapour present on the earth's warmer surface.

The variations in the amount of precipitation in different parts of the world, as shown in the map on page 157, are due to several factors. Much depends on latitude, as will be seen in the following section on air movements. Distance from the sea is of importance because generally air blowing in from the sea contains water-vapour and so brings rain, whereas winds blowing from the land are usually dry winds. The relief of land affects the rainfall: if mountain ranges (as is the case with the Rockies of western North America) lie in the path of rain-bearing winds, the winds drop much of their moisture on the windward slopes of the mountains as the air rises into colder levels to cross the highlands, and the currents of air blow over the leeward slopes as dry winds.¹

MOVEMENTS OF THE AIR

Air is always moving, and its movements, the air currents, have a marked effect on climate. Winds blowing from the north or south may cause a difference of several degrees in the temperature of a place, and a sea or land wind may determine whether it will be wet or fine.

¹ The area to the leeward is known as the "rain shadow" area.

Movements of the air are due to variations in its weight or pressure. Air pressure is measured by a barometer, an instrument based on the fact that the normal weight of the atmosphere at sea-level is sufficient to balance a column of mercury 30 inches (760 mm.) high. Changes in pressure are usually very gradual and very slight, never amounting to more than one or two inches difference. A sudden change heralds the coming of a storm. On maps showing pressure readings, lines called isobars are drawn joining places having equal pressures.

Warm air weighs less (that is has a lower pressure) than cold air, because when the air is warmed it expands, and spreading out over a larger area, becomes lighter, and thus it also rises into the upper levels of the atmosphere ; on the other hand cold air contracts and becomes heavier (that is, produces high pressure), and thus stays in the lower levels of the atmosphere. From this it follows, firstly, that there are certain definite pressure belts on the earth, zones of low pressure in hot regions, zones of high pressure in cold regions¹ ; and secondly, when warm air rises, it allows cold air to flow into its former place, that is, winds blow from regions of high pressure to regions of low pressure.

As it is hot at the equator and cold at the poles, one would expect winds to blow constantly due south and north from the high pressure polar areas to the low pressure equatorial region. This is indeed the basis of the world's wind systems, but as the maps on page 154 indicate, it is somewhat complicated by other factors, such as the rotation of the earth, the varying height of the atmosphere, the distribution of land and water, and the relief of the land.

PLANETARY WINDS.—There are three main sets of winds due to the presence of a low pressure belt at the equator and high pressure areas at the poles. These are the *trades*, the *westerlies* and the *polar easterlies*, and they are known as planetary winds.

¹ It may be well to remember that low pressure goes with high temperatures, high pressure with low temperatures.

Around the equator there is a permanent belt of low pressure, a region of calms, called the Doldrums, where the heated air is always rising. When the air reaches the upper colder levels of the atmosphere, its water-vapour condenses and falls as the daily rains of these latitudes. The air continues to rise until it reaches the stratosphere,¹ when it divides and, in two great streams, flows north and south towards the poles.

Since the earth is rotating, the air currents cannot flow directly north and south. They are deflected more and more to the east,² until they reach their greatest deflection at about Latitudes 30° N. and 30° S., where the stratosphere lies nearer the earth than at the equator. Here the air piles up in great heaps, and as more keeps flowing in, some is forced to descend to the earth. As it descends it becomes compressed and heavier, causing in the two areas belts of high pressure, which are known as the Horse Latitudes.

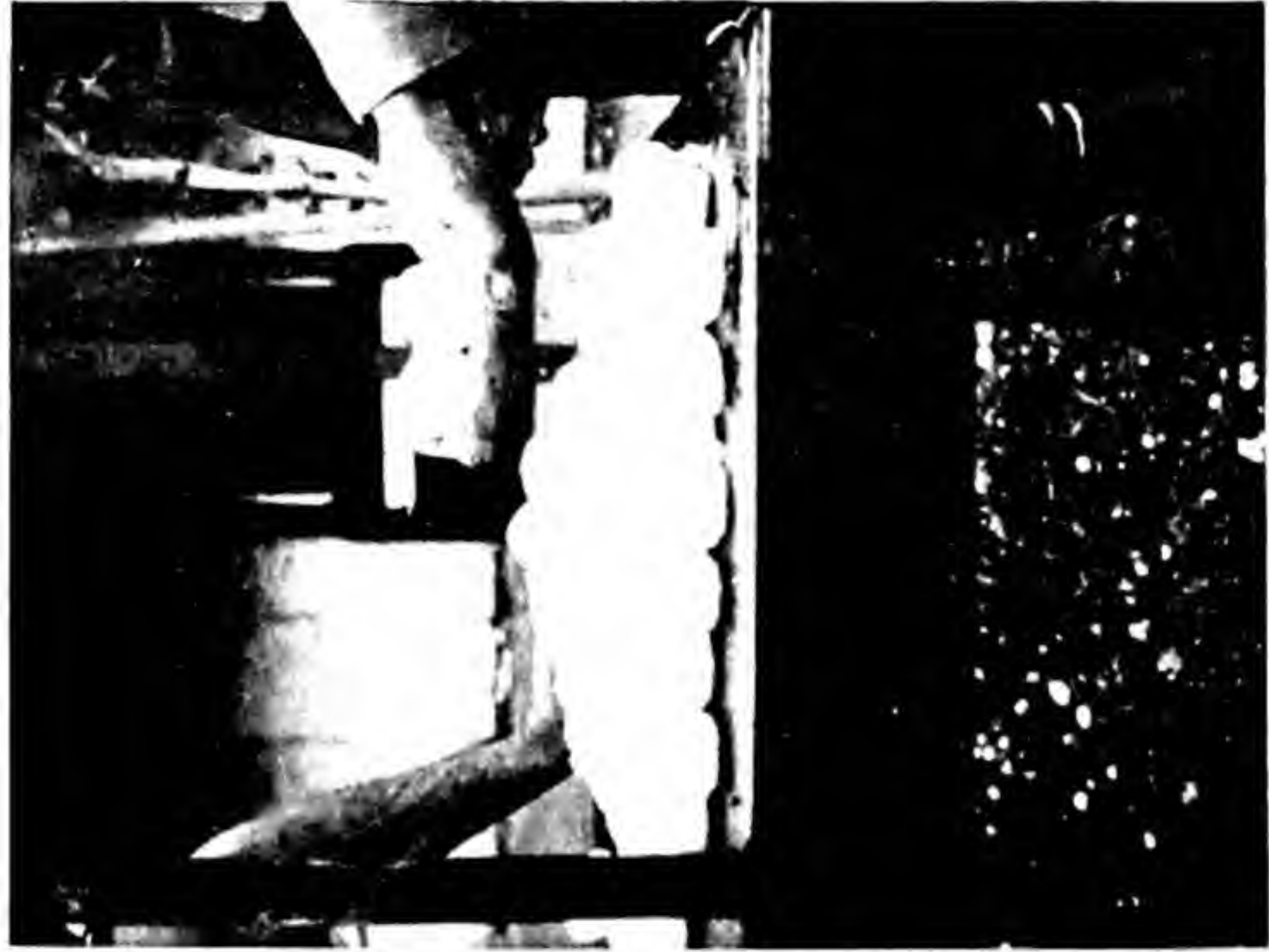
Descending air is dry, for it is coming from colder to warmer levels, and hence it is in the Horse Latitudes that many of the world's great deserts are situated, such as the Sahara, the Arabian and Indian deserts in the northern hemisphere, and the Australian desert in the southern hemisphere.

The continually descending air forces the surface air in each high pressure belt to flow out northwards and southwards. The winds that blow towards the equator from both belts are the steady north-east trades of the northern and the south-east trades of the southern hemispheres. Those that blow towards the two poles are the less constant westerlies, which blow mainly from the south-west in the northern hemisphere and from the north-west in the southern hemisphere.

The westerlies cannot blow as far as the poles, for at the poles there is a high pressure area due to the constant low temperatures, from which winds (the polar easterlies) blow outwards.

¹ The distance of the stratosphere from the earth is not the same all round the planet. It is farther at the equator than in other regions, and lies nearest the earth at the poles.

² Owing to the earth's rotation from west to east.



Lightning striking a building at the Mission, 1900-1901. Dr. D. D. Dyer.
 HALL-1001-11-10-1901



A Kialak snapshot.
 LIGHTNING (page 174)

The westerlies meet the polar easterlies at about Lat. 60° north and south of the equator, and this meeting of inblowing air currents forces the surface air to rise, causing the area in each case to be one of low pressure, which is known as the Polar Lows or Sub-polar Front. It is thought that from these areas originate the cyclones and anticyclones that give rise to the sudden weather changes experienced by lands situated in the track of the westerlies.

“Modern science has shown that knowledge of weather conditions in the north is one of the principal bases for long period weather forecasts.”

OTTO SCHMIDT

“Recent years have witnessed a widening interest in polar meteorology, especially that of the south polar regions; and as a consequence of the activities of various expeditions more people are beginning to realise that the great polar ice-caps play a dominant—perhaps even a predominant—rôle in maintaining the broad circulation and movements of air on which depend the climates of the world, and with them all human activities.”

RICHARD E. BYRD

Cyclones and *anticyclones* are huge whirls of air which may be anything up to 2,000 miles in diameter. They are blown by the westerlies across the middle latitudes at about 25 miles an hour. A cyclone is an eddy of air with a low pressure area at its centre to which winds blow inwards, an anticyclone has a high pressure area at its centre from which winds blow outwards. Therefore a cyclone usually brings rainy weather and an anticyclone dry weather, but wherever either a cyclone or an anticyclone passes, the winds there are first from one direction and then veer until they come from the opposite direction, and consequently vary as to whether they are warm or cold, dry or wet winds, according to the direction from which they blow.

The three world pressure belts, the equatorial lows, the horse latitude highs and the polar lows, move north or south according to the seasonal changes of temperature. In March and September the low pressure zone is over the equator, by June it has moved north and is over the Tropic of Cancer, by December over the

Tropic of Capricorn, and the other zones move correspondingly.¹ The winds of course move with the pressure belts. This seasonal movement of the equatorial low pressure belt causes the hot weather rainy season in tropical lands, and the shifting of the high pressure zone of the horse latitudes leads to the winter rains of lands with "Mediterranean" climates which are then in the track of the westerlies.

MONSOONS.—The pressure belts that cause the planetary winds are interrupted in certain parts of the world by abnormalities in temperature (and therefore in pressure), caused by the distribution of land and water masses. Land takes in and gives out heat more quickly than water, so that where there is a large land area, temperatures over it become very high in summer and very low in winter, and consequently whatever its latitude, an area of low pressure in summer and high pressure in winter will develop over the centre of the land mass, to which in summer there will be inblowing rainy winds, and in winter outblowing dry winds. Such seasonal winds are known as monsoons, and they are most marked over Asia, the world's greatest land mass. The monsoons affect almost the whole of this continent, the greater part of which relies for its rainfall on the summer monsoon.

"The winds in those parts, which they call the Monsoon, blow constantly, altering but a few points: six months southerly, the other six northerly. The months of April and May, and the beginning of June till the rains fall, are so extremely hot that the wind, blowing gently, receives great heat from the parched ground and thus affects those that get the breath of it. Sometimes the wind blows very high in those hot and dry seasons, raising up thick clouds of dust and sand, which appear like dark clouds full of rain."

EDWARD TERRY

Monsoons are experienced in other parts of the world, but on a much smaller scale. They occur in the southern part of the

¹ The position of the earth in relation to the sun at these dates should be noted (see pp. 41-44).

United States (around the Gulf of Mexico), in northern Australia, and in west-central Africa around the Gulf of Guinea.

LOCAL WINDS.—*Land and sea breezes* are experienced in coastal regions in warm weather. They are monsoons on a tiny scale. During the day the land heats up quickly and warms the air above it; the heated air rises and colder air from over the sea flows in to take its place. This is the origin of the cool sea breezes so appreciated by summer visitors to seaside resorts, and by dwellers on tropic islands. At night the opposite occurs: the land cools more rapidly than the sea and the winds blow off-shore.

“Although we were so near the Equator we did not suffer so much from the heat as might have been expected, for there was always a wind blowing from the ocean over the land, bringing a grateful sense of coolness with it.”

FRANK BENNETT

Mountain and valley breezes are daily occurrences in hilly regions. During the day the valley becomes heated and the warm air expands and flows up the hillsides. At night, when the valley cools, the air contracts and cold air blows in down the mountains. This cold air collects at the bottom of the valley, giving rise to frost in the valley itself while the foothills (where the air is moving) are free from frost, a fact local fruit growers take advantage of.

Another type of wind due to the presence of mountains is the *Chinook* or *Fohn Wind*. This occurs when the mountains form a barrier to the prevailing wind. As the air descends it becomes compressed and therefore blows as a warm dry wind. Such winds are welcomed during the cold winters in the Swiss valleys and on the Calgary plains of western Canada.

The winds so far mentioned may blow at any speed from 1 to 25 miles an hour. At 1 mile an hour we may notice smoke from chimneys being wafted lightly in a particular direction. At 25 miles an hour we see and hear the trees bending and tossing their branches, dust and paper being swirled about. There is an instrument (an anemometer) for measuring the speed of the wind,

but as this is not very satisfactory or in common use, usually the rate is gauged by the "Beaufort Scale".¹

Ordinary winds are often known by special names when they blow with particular violence. Among these are the *sirocco* of southern Europe, the *harmattan* of West Africa, and the *khamisin* of Egypt, which are all hot dry winds blowing from the high pressure area in the Sahara Desert. Similar winds are the *simoom* or *samiel* of Arabia, the *Santa Ana* winds of California, the *zonda* of Buenos Aires (Argentina), and the *brickfielders* of New South Wales (Australia). In the same way specially strong winds from polar regions are called *mistral* or *bora* in southern Europe, the *southerly burster* in New South Wales, and *pamperos* in Argentina; cold winds from the Swiss Alps are called *bise* in Southern France and *tramontana* in Italy, and strong easterly winds in the Mediterranean are known as *levanters*.

STORMS.—When the speed of the wind is about 40 miles an hour it is described as a gale, and when it is very violent, as a storm. Storms occur when the conditions that give rise to ordin-

¹ The Beaufort Wind Scale that follows was prepared by Admiral Beaufort in 1806 and revised later :

			Speed in miles per hour
0. Calm	-	Smoke rises vertically	0-1
1. Light air	-	Direction shown by smoke, not vanes	1-3
2. Slight breeze	-	Wind felt in face, leaves rustle	4-7
3. Gentle breeze	-	Leaves and twigs in constant motion	8-12
4. Moderate breeze	-	Raises dust and loose paper, moves small branches	13-18
5. Fresh breeze	-	Small trees in leaf begin to sway	19-24
6. Strong breeze	-	Large branches in motion; umbrellas used with difficulty	25-31
7. High wind	-	Whole trees in motion; inconvenience felt walking against wind	32-38
8. Gale	-	Breaks twigs off; impedes progress	39-46
9. Strong gale	-	Chimney pots and slates removed	47-54
10. Whole gale	-	Trees uprooted; considerable damage done to houses	55-63
11. Storm	-	Widespread damage, very rare inland	64-75
12. Hurricane	-		Above 75



SANDSTORM (page 175)

Courtesy of the Imperial Institute



Courtesy of the Meteorological Office, Air Ministry (Photo, Sgt. R. Pleasants)

TORNADO (page 174)

ary winds are more extreme than usual. If there is a sudden rise or fall in air pressure, the air will rush in or flow out very rapidly, causing a storm.

Certain storms are known by special names, the commonest being *thunderstorms*. These occur when there are very strong ascending currents of air, and so are usually connected with heat, being frequent in the tropics, and during the summer in middle latitudes. As the air rises the water-vapour in it condenses, and it is thought that *lightning* is caused through electricity being released when raindrops are carried upwards, and *thunder* is caused through the sudden expansion of air due to the heat of the lightning.

"One night an unusually severe storm rushed on to the mountains. The sharp detonations like explosions were followed by such thumping and crackling that one's head throbbed unbearably. The storm lasted fifteen hours. It began at 10 p.m. and finished in the middle of the following afternoon. The rain did not cease falling in straight sheets."

EVELYN CHEESEMAN

A special type of violent thunderstorm, the *tornado*, is experienced in the southern United States, and occasionally in India, Australia and western Europe. It consists of a whirling mass of air surrounding a centre of ascending air. Tornadoes cause much damage, but fortunately are very small in area (from 100 to 500 yards in diameter), and occur infrequently. The term *tornado* is applied only to such storms on land, the equivalent storm in the desert being called *dust devil*, and at sea a *waterspout*.

"In the forenoon a waterspout took place at a few miles' distance and was to me a very interesting phenomenon. From a stratus or black bank of clouds, a small dark cylinder, shaped like a cow's tail, depended and joined itself to a funnel-shaped mass which rested on the sea. It lasted some moments and then the whole appearance vanished into an exceedingly heavy rain storm. When they approach near to a vessel, it is usual to fire a big gun in order to break them."

CHARLES DARWIN

Tropical cyclones are known as *hurricanes* in the southern United States, the West Indies and Central America, as *typhoons*

or *tornadoes* in eastern China and India, and *Willy Willies* in northern Australia. They are similar to the cyclones of middle latitudes but consist of smaller whirls of air moving at such vastly greater speeds that they sometimes are very destructive. Tropical cyclones are believed to originate from heated areas giving rise to intensely low pressures over the central Pacific and central Atlantic Oceans. They have a diameter of from 100 to 500 miles, move at speeds of anything up to 100 miles an hour, and cause great tidal waves. Such storms are not frequent, there being only from five to twenty yearly, and they die away into ordinary cyclones after travelling a few miles over the land.

“Anyone who has not been caught in the throes of a tropical cyclone can form little idea of its severity. I once had such an experience of it and it will live for ever in my memory. I accompanied a trawler on a trip from Sydney to Brisbane. In a short time the wind was blowing at eighty miles an hour. For two days and nights we plugged against it, now descending into a great trough, now ploughing our way up the crest. Battened down, the air was hot and stifling. Yet there was no relief on deck, for one could not withstand the force of the seas that swept continually over it.”

T. C. ROUGHLEY

In desert areas strong winds cause the *sandstorms* so dreaded by travellers :

“The sky now became black. Whirling sand almost blotted out the atmosphere. Clouds of sand came towards us like moving, misty hills in Scotland ; they entered our ears and nostrils and eyes, and we all veiled our faces. It became worse ; the sand hit us as we walked along bent down to prevent our becoming blind, cut our hands and faces like whipcords, and we struggled on. When I reached the post I was blind, couldn't open my eyes, suffered excruciating pain, and was taken in hand by the doctor, and shut up in a dark room for several days with bandaged eyes.”

D. CAMPBELL

In polar regions gales are often accompanied by sleet and snow. These storms are called *blizzards* by Americans and Europeans, and *buran* or *purga* by Siberians.

TODAY'S WEATHER

(July 3rd)

LONDON, S.E. ENGLAND.—Wind backing S.W., mod.; mainly fair; becoming warmer.

E. ENGLAND, E. & W. MIDLANDS.—Wind W., mod.; mainly cloudy, light local rain; becoming warmer later.

S.W. ENGLAND, S. WALES.—Wind backing S., mod.; mainly cloudy, local coast fog later; rather close.

N. ENGLAND, N. MIDLANDS, N. WALES, SCOTLAND.—Wind W., mod.; fair early, then occasional rain or drizzle; rather cool.

ORKNEY & SHETLAND.—Wind N.W. to W., mod.; bright periods, some showers; rather cool.

IRELAND.—Wind backing S., mod.; cloudy or dull, occasional drizzle, some coast fog in S. later; becoming close.

ENGLISH CHANNEL.—Sea moderate, decreasing.

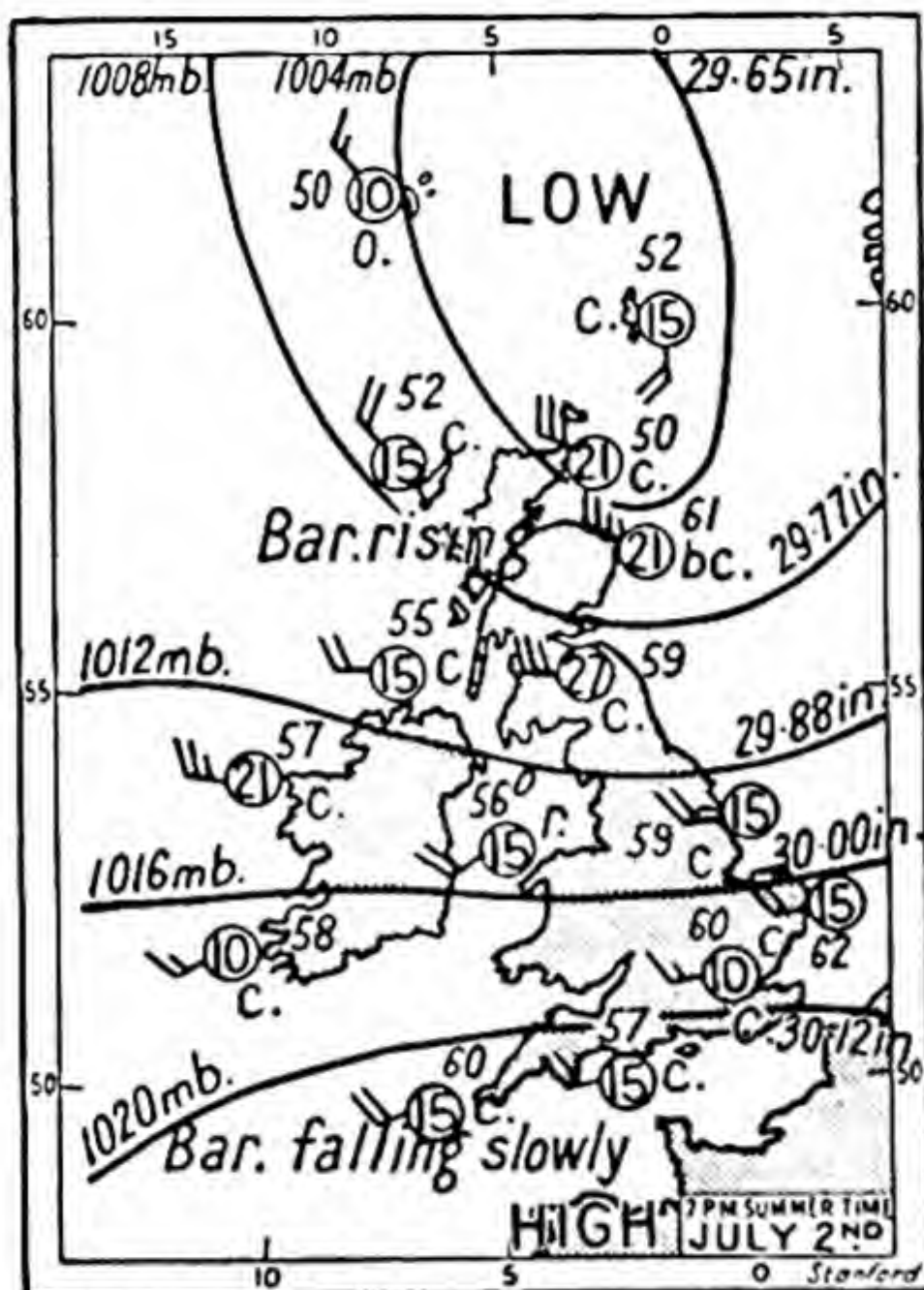
FURTHER OUTLOOK.—Continuing unsettled, but warmer.

AIR ROUTES TO CONTINENT.—Wind W., 10-15 m.p.h. on surface, 25-30 m.p.h. at 3,000 ft. Thundery showers with broken cloud inland on Continent. Mainly cloudy with base 2,000 ft. in S.E. England. Visibility 5-15 miles.

Lighting-up time, 10.18 p.m.
Sun rises 4.50 a.m.; sets 9.18 p.m.

High water, London Bridge, 3.56 a.m.; 4.2 p.m.

Moon rises 9.58 p.m.; sets 7.52 a.m. tomorrow.



Anticyclone over France is moving N.E. and depression over Shetland will fill up. Shallow disturbance 500 miles W. of Ireland will move E. Weather will be unsettled, with rain or drizzle spreading to W. and N.W. districts, but there will be showers and bright periods in E.

EXPLANATION OF MAP

Atmosphere Pressure.—The continuous lines are isobars. At all places at sea-level on any one of these lines the pressure (or height of the barometer) is the same—namely that given in millibars and inches at the end of the line (1,000mb = 29.53 in.). Regions of high and low pressure are indicated by the words "High" and "Low" respectively. When a heavy arrow is drawn outwards from a low pressure centre its direction indicates the expected direction of movements of the system and its point indicates the expected position of the centre at six o'clock (G.M.T.) this morning.

Wind.—Direction is shown by arrows flying with the wind and force is shown by the figures within the circles which indicate the velocity in miles per hour near the ground and by the number of feathers on the arrows as follows: 1, Light Air; 1, Slight Breeze; 1½, Gentle Breeze; 2, Moderate Wind; 2½, Fresh Wind; 3, Strong Wind; 3½, High Wind; 4, Gale; 4½, Strong Gale; 5, Whole Gale; 5½, Storm; 6, Hurricane.

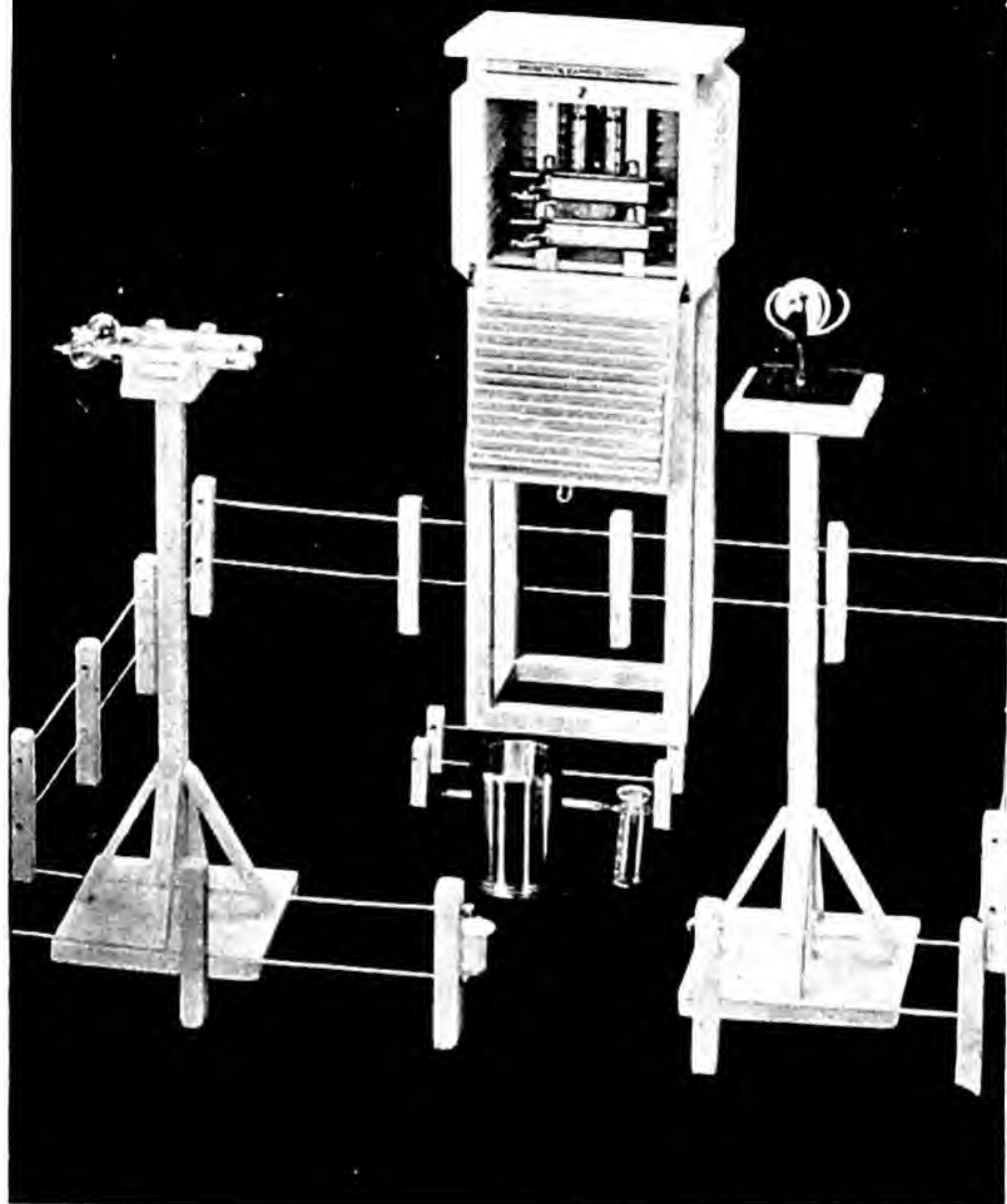
Temperature in degrees Fahrenheit is shown by the figures.

Weather Conditions are indicated by letters near the small circles: b, Blue Sky; bc, Sky half-clouded; c, Cloudy; d, Drizzle; f, Fog; g, Gloom; l, Lightning; m, Mist; o, Overcast; p, Passing Shower; q, Squalls; r, Rain; h, Hail; rs, Sleet; s, Snow; t, Thunder; thr, Thunder-storm; u, Ugly, threatening sky; y, Haze.

By courtesy of the "Daily Telegraph and Morning Post"

A LONDON NEWSPAPER WEATHER REPORT

(Note that the forecast for the day is based on the previous evening's weather conditions)



Courtesy of Negretti & Zambra

INSTRUMENTS OF A METEOROLOGICAL STATION

On the tall stand at the left is the *Solar Maximum Thermometer* with bright and black bulbs; on the equally tall stand at the right is the *Stokes Campbell Sunshine Recorder*; the cabinet in the middle, which stands highest in the picture, is the *Stevenson Screen* containing maximum and minimum thermometers, as well as wet and dry thermometers; the little instrument that appears as though it were attached to the small left-hand gatepost in the foreground is the *Earth Thermometer*, which has a pipe dug into the ground; near this gatepost inside the enclosure is the *Rain Gauge*, whose *Measuring Jar* is shown beside it; between the rain gauge and the legs of the cabinet is the *Ground Minimum Thermometer*.

“ Then along comes a walloping blizzard. The peace is shattered as if by a violent concussion ; the world becomes a vindictive, brooding extravagance of plunging wind, foaming breakers of drift, furious shadows, as if the Barrier were disintegrating. The sound fills and dulls the ears until it ceases to hear them. But in the night, something indefinable, like the lifting of a pressure, will awaken you out of a shallow sleep. Then you recognise it for what it is : the quiet, the creeping rustling quiet of great cold—ah, the wind has stopped! ”

RICHARD E. BYRD

WEATHER FORECASTS.—As all countries have special arrangements for the observation of weather conditions (temperature, precipitation and winds), many broadcast and publish in the newspapers forecasts of the weather to be expected. By this means it is possible to guard to some extent against the dangers to life and property that may be caused by fog, frost, storm and flood.

CLIMATE REGIONS

According to the prevailing weather conditions, the world can be divided into certain main climate regions. These, however, merge gradually one into another, and also many variations from normal occur within each region owing to such factors as local relief, the presence or absence of inland waters, and changes due to man's use of the land.

From the point of view of average temperatures, the world may be divided into four zones: the *tropical* lands of low latitudes where winter is unknown, as temperatures never fall below 50° F. ; the *warm temperate* lands of middle latitudes where there is a short mild winter, during which average temperatures are never less than 32° F. ; the *cool temperate* lands, also of middle latitudes, where winters may last from two to five months and temperatures may average below freezing point ; the *polar* lands of high latitudes where winters of six months or more with temperatures below 0° F. are experienced.

When the yearly precipitation is also considered, each of the four zones can be subdivided according to the amount of rainfall received and the time of the year in which this occurs.

THE TROPICAL ZONE contains three subdivisions, and, since the rainfall of this zone depends on the seasonal shift north and south of the equatorial pressure belt, these subdivisions vary according to their distance from the equator. They are : the *equatorial forest* belt which has rain at all seasons, the *tropical savannah* areas (lying north and south of the equatorial belt) which receive rain in the hot season, and the *tropical arid* lands (still farther north and south) where the rainfall is very scanty.

THE TEMPERATE ZONE (warm temperate and cool temperate lands) depends for its rainfall largely on the westerlies, and in eastern Asia and southern United States on south-eastern monsoon winds ; therefore differences occur between western and eastern areas in each continent. The temperate zone consists of five subdivisions : the *warm temperate western* or *Mediterranean* region where there is a short rainy winter and long dry summer ; the *warm temperate eastern* lands of abundant rain which falls mainly in spring and summer ; the *cool temperate western* or *oceanic* regions with rain at all seasons, mild winters and cool summers ; the *cool temperate eastern* and *continental* regions with rain chiefly in summer, cold winters and hot summers ; and the *temperate arid* lands where there is very little rain.

THE POLAR ZONE contains a *coniferous forest* belt where there is sufficient precipitation and warmth for the growth of trees, a drier and colder *tundra* area where mosses and short grass appear during the brief summer, and a *barren* ice-capped region where no life can exist.

HIGHLAND AREAS form the exceptions to the above-mentioned regions, for they make their own climate irrespective of the zone in which they are situated. Lofty mountains, even in the tropics, have snow-capped summits, that is their peaks experience the same climate conditions as the polar barrens.

And between the base and summit of a mountain there are different kinds of climate regions.

“Altitude does correspond roughly to latitude, and the zones of vegetation from the Equator to the Pole can be traced in a condensed form on the face of the mountain between 3,000 feet and 15,000 feet.”

F. KINGDON WARD

EXERCISES

1. Explain : Mountains make their own climate regions.
2. Write short notes on : stratosphere, clouds, monsoons, chinook winds, cyclones and anticyclones.
3. What are : the Appleton Layer, troposphere, isotherm, isobar, isohyet, precipitation, blizzard, sandstorm, tornado, hurricane?
4. State why there are three world pressure belts and how these give rise to the planetary winds.
5. Rewrite, filling in the missing words :

Climate depends on two things, — and —. Temperature is the — or — of the air, and it varies in different places according to their — from the equator, — above sea-level, and distance from the —. Precipitation can be in the form of —, —, —, —, — and —, and depends largely on prevailing —. The world can be divided into four zones according to temperatures : the — zone where winters are unknown, the — — regions which have hot summers and mild winters, the — — lands where summers are warm and winters cold, and the — regions where summers are cool and short and winters long and very severe. These zones can be subdivided according to their precipitation. The tropical zone contains an — — belt with all the year rain, — — regions with summer rain, and — lands where there is little or no rain. The temperate zone contains the — — — lands with hot dry summers and mild rainy winters, the warm temperate — lands with hot rainy summers and mild winters, the cool temperate western lands with — summers and — winters and — —

— rain, the cool temperate eastern lands with — summers, — winters and rain mainly in —, and the arid lands of — rainfall. The polar zone contains three subdivisions, a belt of — — where there is sufficient warmth and precipitation for tree growth, a tundra area where the weather is — and —, and an ice-cap region where it is too cold for — to —.

COMPOSITION

How Climate Affects Mankind.

LOCAL STUDY

Keep a daily wind chart, describing the winds in your neighbourhood according to the Beaufort Scale (p. 172).

HANDWORK

Draw a line down the left-hand side of a piece of squared or plain paper, and divide it up to show every 10° of temperature from 0° to 100° . Draw another line along the bottom of the paper and on it mark twelve divisions, one for each month of the year. Now using the details given below (the average monthly temperatures in degrees fahrenheit for each of the towns), draw temperature charts for the towns mentioned.

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Buenos Aires	-	74	73	69	61	55	50	49	51	55	60	66	71
Cairo	-	53	55	61	68	74	79	81	81	76	72	64	56
Calcutta	-	65	70	79	85	86	85	83	82	83	80	72	65
Cape Town	-	70	70	68	63	59	56	55	56	58	61	64	68
London	-	39	40	42	47	53	59	63	62	57	50	44	40
Sydney	-	72	71	69	65	59	54	52	55	59	63	67	70
Tokyo	-	37	39	44	55	62	69	76	78	71	60	51	41
Toronto	-	22	21	30	42	54	64	69	67	60	49	37	27
Wellington	-	62	62	61	57	53	50	48	49	51	54	57	61

GAME

Someone describes a typical climate during a given season. The one who first names a place where such weather conditions might be experienced, provides the next description.

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CHAPTER SEVEN

ZONE	TYPE	APPROXIMATE			NATURAL VEGETATION	MAIN CULTIVATED PRODUCTS	CHIEF ANIMAL LIFE
		LATITUDE	TEMPERATURE	RAIN-FALL			
TROPICAL	EQUATORIAL FOREST	0°-10°	high temperatures (above 50° F.) all the year round	all the year	<p> mahogany, ebony, logwood, palms, rubber, chicory, Brazil nut, tonka-bean, tagua-nut, spices, fruits </p> <p> teak, sal, bamboo, sandal-wood, mate, quebracho </p>	<p> rice, manioc, maize, millet, sugar-cane, tobacco, cotton, ground-nuts, bananas, pine-apples, mangoes, etc. </p> <p> cocoa, rubber, coconuts, palm oil, palm spices, tea, coffee, yute, sisal, hemp, cotton </p>	<p> monkeys, snakes, elephant, tiger, lion, jaguar, leopard, rhinoceros, hippopotamus, crocodile, etc. </p> <p> gorilla, orang-utan, sloth, tapir </p>
	TROPICAL FOREST	10° - 20°		in summer (very heavy)	tall grass with scattered trees	<p> dates </p>	<p> giraffe, zebra, antelope, kangaroo, cattle, sheep </p>
	TROPICAL GRASSLAND			in summer	occasional grass, thorny plants, cacti, date and dom palm		<p> cattle, wild ass, gazelle, hyena </p>
	TROPICAL ARID LANDS	20°-30°		very scanty			
TEMPERATE	WARM TEMPERATE EASTERN	30° - 45°	hot summer, mild winter	in summer	grass (pampas type) and forest (cypress, oak, camphor, conifer)	<p> sugar-cane, cotton </p>	<p> silkworm, ostrich </p>
	WARM TEMPERATE WESTERN		hot summer, cold winter	in winter	maquis (aromatic herbs) and woodland (cork-oak, olive, acacia)	<p> olive, vine, citrus fruit </p>	
	TEMPERATE ARID	30°-50°		very scanty	poor grass	<p> cotton </p>	<p> fat-tailed sheep, wild horse </p>
	COOL TEMPERATE WESTERN	45° - 55°	warm summer, mild winter	all the year	forest (oak, elm, beech, pine) and grassland	<p> wheat, barley, oats, rye, flax, potatoes, sugar-beet, soy-beans, vegetables, apples, plums, cherries, etc. </p>	
POLAR	COOL TEMPERATE EASTERN AND INTERIOR		hot summer, cold winter	in spring and summer	grass (steppe type), some forest (oak, ash, elm, pine, fir)		
	CONIFEROUS FOREST	55°-65°	short warm summer, cold long winter	slight all the year	forest (spruce, larch, birch, fir, pine)	<p> a little barley, rye and potatoes </p>	<p> sable, ermine, beaver, mink, muskrat, etc., caribou </p>
	TUNDRA	65°-70°		scanty	moss, lichen, grass		<p> reindeer, fox, polar-bear, seal, walrus </p>
	ICE CAP	70°-90°	always very cold	scanty			<p> penguins </p>

WORLD CHART: VEGETATION AND ANIMALS

VEGETATION AND ANIMAL LIFE

INTRODUCTORY

Plant and animal life provide man with much of his food, drink and clothing, and also the raw materials with which many of his necessities and luxuries are manufactured. Plant life, however, is the more important, for on it the animal life depends.¹

“Hence a traveller should be a botanist, for in all views plants form the chief embellishment.”

CHARLES DARWIN

The vegetation of any place depends mainly on the climate. The exceptions to this rule are due to the extent of the fertility of the soil, and the improvement or impoverishment caused by man. If the soil is not rich, naturally little will grow, in spite of suitable temperature and rainfall conditions. Man can improve such land through draining and enriching it by fertilizers and scientific crop rotation, as has been achieved with the moorlands of the Baltic coast of northern Germany; and also by irrigation schemes, as has been done in many countries throughout the ages, for instance in Iraq:

“For two days we passed through some of the best agricultural land of Iraq, as evidenced by the many water channels which cut the country up into all sorts and sizes of farms.”

A. J. REYNOLDS

On the other hand man may spoil the normal vegetation by producing crops in such rapid succession that the soil is exhausted, as has happened in some parts of western North America. In addition, the usual amount and effect of the yearly rainfall may be affected by the destruction of forests.

“There is a connection between lack of trees and barrenness. It is a sort of vicious circle. Where the hill-sides are plentifully

¹ Animals obtain their food either directly by eating the plants, or indirectly by preying on other animals that are plant feeders.

clothed with trees the rainfall is entangled in them and in their roots, and it soaks into the soil, flowing gently away in perennial streams which irrigate the lowland fields. And so more trees grow, and the land flows with milk and honey, so to speak. But if the trees are destroyed, the water rushes violently down, scouring away the soil, uprooting the few trees that remain, and burying the lowlands deep in débris, just like you see here in the Khyber Pass. And it almost seems as if Nature finally completes the ruin by withholding rain from such accursed lands. The climate seems to change, so there may be some truth in the Afridi legends."

VICTOR BAYLEY

"Three centuries ago the Andalusian hills were covered with forests, which attracted an annual rainfall of about twice the present-day measurement. Timber being wealth only when cut down, the landowners began to denude the land of trees, and, despite warnings, continued the process until to-day, apart from the cork woods around Algeciras, there were few trees left within a radius of 200 miles. Thus they reduced the normal rainfall of the province to a point at which its summers are one long drought. Modern steel bridges spanning river-beds devoid of even a trickle of water in June, testify to the tragedy of those vanished forests of Andalusia."

H. HESSELL TILTMAN

But man's effect in changing the character of the earth's vegetation has been comparatively slight, and the little so far done to improve it has not been an easy task.

"The welfare of India is still bound up with the monsoon, although irrigation schemes have been developed so much in recent years."

LADY HARTOG

"It is but a figment of man's delusion that the earth and all it contains was made for his particular service. The earth is not a servant, nor does nature stand aside at man's beck and call to serve him. Instead it fights every step of the way. The man who goes into the jungle finds that out very quickly. The pioneer farmer who tills the soil knows it too."

WILLIAM LA VARRE

Apart from the few trivial exceptions to the general rule about plant life depending on climate, the world can be divided into

vegetation regions which coincide with the climate regions (see p. 179). Each region possesses its particular type of vegetation and animal life. But naturally the areas merge one into another, so that in some cases plants grow in more than one region. Moreover, man has been able to breed varieties of certain of the hardier plants (such as wheat, oats, rye, potatoes) adapted to withstand the climate of cooler or warmer, wetter or drier areas than those in which they originally flourished. In general, however, plants are grown most profitably and animals reared most successfully in their own natural regions, and it is noteworthy that when they have been taken to new regions having similar climatic conditions (that is moved from one place to another in the same vegetation zone), the results have been often good. Striking examples of this are the cultivation of rubber trees in the East Indies from seeds obtained from Amazonia, and the introduction of potatoes to Europe from America. Sometimes the results were rather too successful, as the bringing of rabbit and prickly pear into Australia, where now both animal and plant are serious pests.

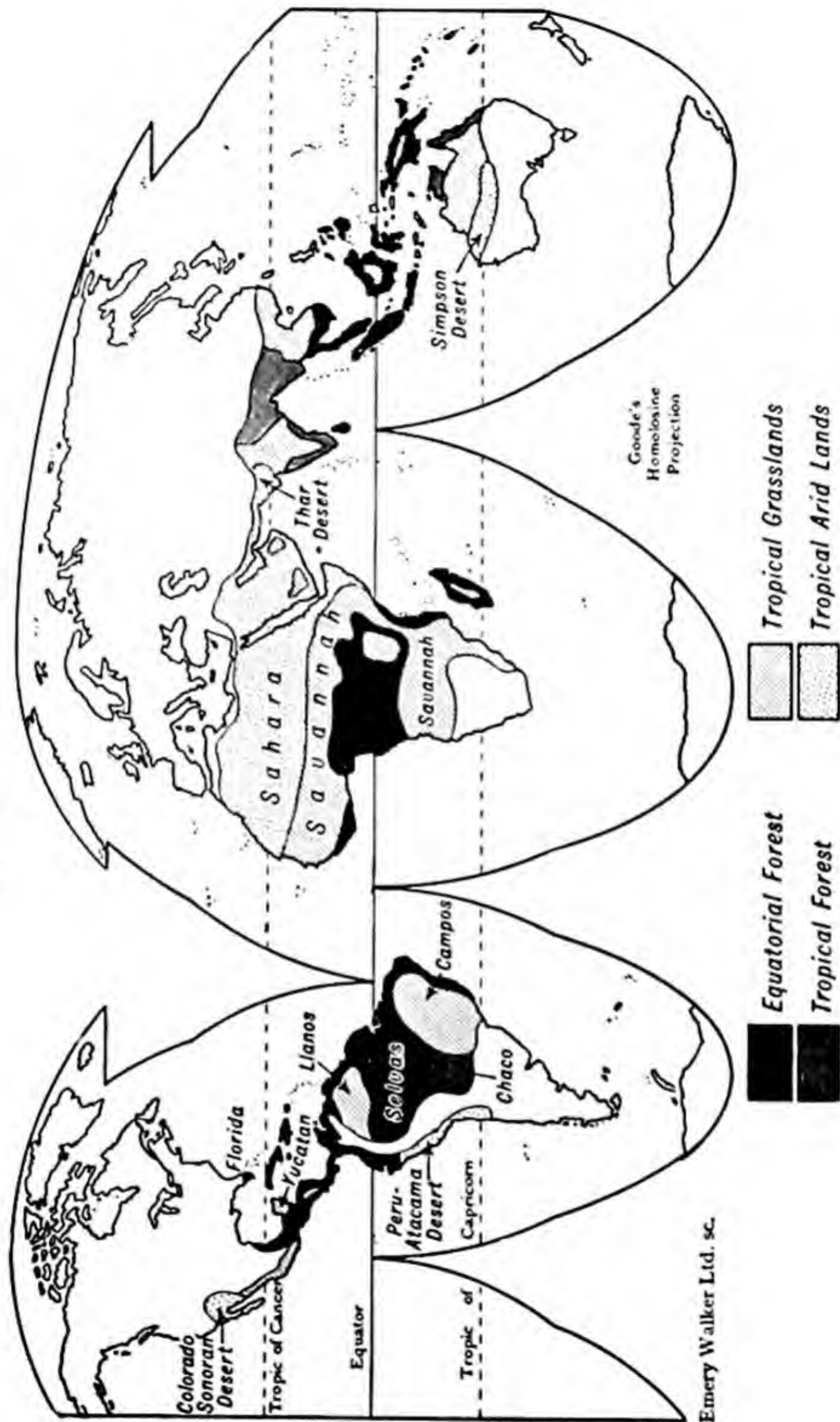
“The introduced pests, such as the prickly pear, the fox, and the rabbit, are crowding the native life from its accustomed haunts. In some districts the prickly pear covers the ground so thickly that it is impossible to walk through it, and the only way about the country is by following the tracks made by wild cattle. These tracks criss-cross in the manner of a most complicated maze and turn in every direction.”

SIR G. H. WILKINS

If plants are taken and cultivated in places outside their natural habitat, often they continue to grow but yield much less than previously, as is the case with sugar-cane crops in the southern United States; or they become diseased and perish, like the mulberry trees which were grown in southern France for the silk industry.

This is very bad book

THE TROPICAL LANDS



CHAPTER SEVEN
THE TROPICAL LANDS
VEGETATION

EQUATORIAL FORESTS.—Lowlands situated on or near the equator have high temperatures and abundant rain throughout the year. The natural vegetation is dense forest, and, since there is unfailing heat and moisture, the plants have no resting season. Trees are never leafless ; as the old leaves fall, buds burst into leaf. Blossoms and unripe and ripe fruit grow on one and the same plant. The main areas that lie within this region are the Amazon basin, the coastlands of Ecuador, Colombia, Venezuela, the Guianas, eastern Brazil, Central America, southern Mexico and the West Indies ; the Congo basin, the coastlands around the Gulf of Guinea, those of East Africa, Madagascar, Ceylon, Malaya, southern Indo-China, the East Indies, and the islands of the Central Pacific.

The trees at many of the coastal districts of these places have been cut down to make space for agriculture, but the vast forests of the Amazon and Congo basins still remain largely untouched. The following describes a typical scene in Amazonia :

“ Ferns spread beside the path, some of them to a breadth twice the span of a man’s arms ; the trees reared up their heads 200 feet above the jungle bush. Looking to right or left, the vision was almost immediately blocked off in an incredible, strangled turmoil of roots, trunks, leaves, creepers and vines. The trail narrowed, as if squeezed into itself from either side by the enormous pressure of vegetable growth. Overhead the summit of foliage of the taller trees often met and mingled, and we passed through a dim green tunnel in faint twilight.”

JAMES RAMSEY ULLMANN

A tremendous variety of plants and trees grow in the forests, as is evident from the following description of an African jungle :

“ There is the strong African teak, the camwood, the African mahogany, the everlasting iron-wood, the no less hard yellow wood by the riverside, infinitely harder than an oak, the ebony, the copal-wood tree with its glossy and burnished foliage, the arborescent wild mango, the small-leaved wild orange, the silver-boled wild fig, the butter tree, the acacia tribes, and the thousands of wild fruit-trees, most of which are unknown to me. Therefore, to understand what this truly tropical forest is like you must imagine all these confusedly mixed together, and lashed together by millions of vines, creepers, and giant convolvuli, until a perfect tangle has been formed, and sunshine quite cut out, except a little flickering dust of light here and there to tell you that the sun is out in the sky like a burning lustrous orb.”

SIR HENRY STANLEY

A number of the trees and plants yield useful products, but their collection and transport are difficult and costly. Travel through the forests is almost impossible, so dense is the vegetation ; plants of the same kind do not grow closely together, but are scattered here and there among a great many other varieties ; the population in such areas is insufficient for extensive exploitation ; and the forests are far away from the world's markets. Therefore although there is some collection of wild products from the forest margins, the greater part of such goods are obtained from plantations in the coastal regions.

The chief timbers exported from the forests are cabinet woods such as mahogany, ebony, rosewood and cedar ; and woods from which dyes are obtained such as logwood.

Many of the coastal areas are bordered by forests of mangrove-trees which can live partly under water. From mangrove-bark a substance used for tanning leather is obtained.

“ The mangroves are green trees which, by means of turning their roots into stilts, invade the tidal mud.”

JULIAN HUXLEY

The powdered bark of the cinchona tree yields the drug quinine. The cinchona grows wild in western Amazonia and is cultivated in Java and Ceylon.

The sap of many of the trees and vines is a milky juice which hardens into rubber when exposed to air. The finest variety is the wild Para rubber of the Amazon basin, but most of that used commercially is obtained from plantations of similar trees in Malaya and the East Indies. A lower grade rubber, known as balata, is also collected, chiefly from British and French Guiana.

“The method of tapping rubber trees varies. The most common and the best is to open up a tree by cutting two vertical lines down the bark, so halving the circumference. These lines are extended up the tree to about 3 feet 6 inches from ground level. From the top of these side-lines two grooves are cut one from each side-line, sloping slightly downwards till they meet. A tin spout is hammered into the bark of the tree 3 inches below this junction, and below the spout is a glass bowl or earthenware cup suspended on a wire frame, the two ends of which are bent at right angles and hammered into the bark, thus keeping the frame in place. The raw rubber, or ‘latex’, flows down the groove, along the spout and so into the bowl. Tapping requires some skill. Only a very thin shaving of bark—just enough to open up the pores—must be removed.” “RANGER”

The sap of certain other trees (such as the chicle-tree of Colombia and Central America, and the jelutong-tree of the East Indies) is used to make chewing gum.

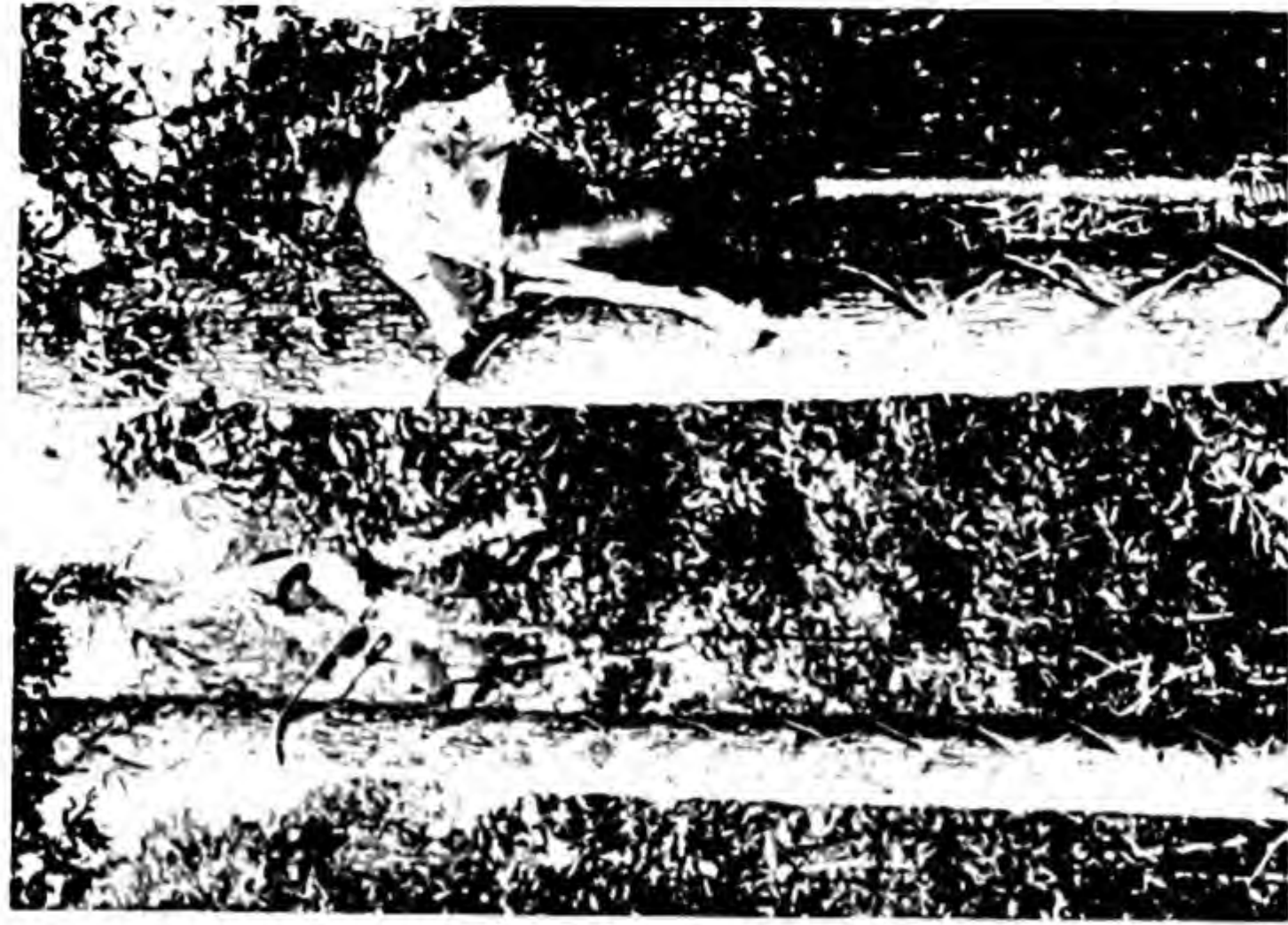
“In the East Indies jelutong is the basis of chewing gum. It is obtained from the jelutong-tree by much the same process as rubber is extracted from the rubber-tree.” JULIUS FLEISCHMANN

The pith of another tree provides us with sago.

“The sago-tree is a palm thicker and larger than the coconut-tree, although rarely so tall. When sago is going to be made, a full-grown tree is selected. It is cut down close to the ground, the leaves and leaf stalks cleared away, and a broad strip of the bark taken off the upper side of the trunk. This exposes the pithy matter. This pith is broken down into a coarse powder. Water is poured on the mass, which is kneaded and pressed till the starch is all dissolved. The water charged with sago starch passes on to a trough where the sediment is deposited. When the trough is



Courtesy of the Malayan Information Agency
HARVESTING COCONUTS IN MALAYA (page 193)



Courtesy of the Imperial Institute
CHICLE TAPERS IN BRITISH HONDURAS (page 191)

nearly full, the mass of starch, which has a slight reddish tinge, is made into cylinders and sold as raw sago.” A. R. WALLACE

The leaves of palm trees supply fibres used for brush-making.

“The graceful raphia overhangs the river at many points, the ends of the fronds often trailing in the water. The midribs, of a yellowish green, are of great strength, and much used by the natives for building and other purposes. In West Africa a product of the raphia called pissava is largely exported, and used in England for making household brushes.” R. C. F. MAUGHAM

On the coastal plains are groves and plantations of coconut-palms. From copra, the dried flesh of the coconut, oil is obtained for use in making medicines, soaps and cosmetics. Much copra and oil are exported. The husk of the coconut yields coir-fibre used for mat-making. Coconuts are harvested either with long poles or thrown down by swift climbers.

“The coconut pickers climb the trees by fixing a rope round their middles, leaning back and working themselves up with their feet ; once up they collect the nuts, flinging them to the ground. The women workers split the nuts where they fall ; then the copra is extracted and dried.” OWEN RUTTER

“The coconut-tree has a hundred uses, and urges man to make spirit from its juice ; ropes, clothes, matting, bags, from its fibre ; oil from its pulp ; it creates an export trade which appeals to almost all men by their weakest side, in offering large and quick returns for little work.” SIR CHARLES WENTWORTH DILKE

Another important oil-yielding tree is the oil-palm, which grows wild in the African forests and is cultivated in the East Indies.

“The full-grown oil-palm attains a height of about 60 feet. The fruit consists of an outer covering which contains the palm oil of commerce, and the palm nut. The oil, after being boiled, yields a pleasant and yellow-coloured fat, most of which is exported to Europe and used for various purposes by the soap-maker and Chandler.” H. OSMAN NEWLAND

From the forests of South America brazil-nuts, tonca-beans and tagua-nuts are exported.

“The ‘ Para chestnut ’ or Brazil-nut grows on a tree so high

that it is never climbed for its fruit. The nuts ripen during the rainy season and fall to the ground by hundreds. In its native state the fruit is about the size and shape of a husked coconut, but with a shell so hard that a loaded cart passing over it will not crack it. Strangely enough, monkeys have a way of breaking them open. Broken with an axe or hammer, each shell yields from twenty to thirty nuts set tightly together like segments of an orange."

HARRY A. FRANCK*

"The tree upon which the tonca-bean grows resembles the mango, with spreading branches and deep-green, dense leaves. The fruit also is very similar to the mango, though green, with tough fibrous flesh and a large seed. Upon ripening, the fruit falls, when it is gathered into heaps and dried; the seeds are later cracked open and the strong-smelling kernel extracted. It is used in making perfumes and flavouring extracts." L. E. MILLER

The hard, white tagua-nuts are known as vegetable ivory, and used for making collar studs and buttons.

"Many tagua or ivory-nut palms grow beneath the tall trees; their fruit is one of the important articles of export from the Magdalena Valley (Colombia) and, during August and September, many thousands of bags are shipped down the river."

L. E. MILLER

Fruits of all kinds abound.

"Among the fruits are the orange, the Avocado pear, the pawpaw and the banana. The West African orange looks like a lemon from the exterior. The Avocado pear attains a height of from 25 to 30 feet; the flesh surrounding the stone is yellow and green, soft and buttery, with a delicious flavour; the fruits are usually eaten raw with pepper and salt or with lime juice. The pawpaw-tree is of rapid growth and will thrive in almost any soil; the flavour is similar to that of melon, and the fruit is most wholesome. The banana is one of Nature's most useful as well as most delightful plants. A handsome shrub with its long broad-fringed leaves of an unrivalled green, it adorns many a plantation of rubber, kola, coffee, or cacao, because of the shade it affords to these plants when young, and also because of the



MANGROVE TREES (page 190)

Courtesy of the Imperial Institute



PINEAPPLE PLANTATIONS IN HAWAII (page 196)

Courtesy of the Canadian Pacific

luscious and sustaining fruit it yields in a cluster or bunch—only one bunch per tree—which weighs almost half a hundredweight. The natives use the leaves to wrap up all kinds of fruits and nuts, the stem and its inner portion as sponge and soap, and as an antidote against snakebite ; the ripe fruit they also use to make beer.”

H. OSMAN NEWLAND

“ In Uganda every hill and valley is covered, where habitations are, with cleanly kept banana plantations. Its present uses are : (a) as the food-staple of the country—it is cooked green in a score of ways, and is also sliced, dried in the sun, and pounded into flour ; (b) the ripe fruit produces the cider of the country, the universal beverage ; (c) from the skins is extracted a potash, from which a very serviceable soap is made ; (d) the stem, when beaten into a pulp, is used as a native towel.”

F. D. LUGARD

“ The pineapple plants are about 18 inches high, with a single ‘ apple ’ standing on a spike.”

G. MANINGTON

“ The first thing to do is to eat a mango. Will it be as good as you are told it is? Yes, it is better. At first you think it is just an ordinary apricot, and then you think it is a banana ; no, fresher ; a peach, a strawberry, and then a delicious, sharp, fresh aromatic after-taste comes, slightly tinged with turpentine, but not bitter. Then you get all the tastes at once, and you know that the mango is like nothing else but its own incomparable self.”

MAURICE BARING

“ I enjoyed a luxury—the true bread-fruit. It is baked entire in the hot embers, and the inside scooped out with a spoon. I compared it to Yorkshire pudding ; Charles Allen said it was like mashed potatoes and milk. It may be eaten sweet or savoury. With meat and gravy it is a vegetable superior to any I know, either in temperate or tropical countries. With sugar, milk, butter, or treacle, it is a delicious pudding, having a very slight and delicate but characteristic flavour, which, like that of good bread and potatoes, one never gets tired of.”

ALFRED RUSSEL WALLACE

These regions also provide us with spices : ginger (the dried root of a plant), cinnamon (the bark of a tree), nutmeg (a kernel),

mace (the nutmeg's covering flesh), cloves (the dried flower-buds of a tree), pepper (the berry of a climbing plant), vanilla (the pod of a climbing vine).

"In some parts of these forests I saw the vanilla growing luxuriantly. It creeps up the trees to the height of 30 or 40 feet. I found it difficult to get a ripe pod, as the monkeys are very fond of it, and generally took care to get there before me. The pod hangs from the tree in the shape of a little scabbard. Vayna is the Spanish for a scabbard, and vanilla for a little scabbard; hence the name."

CHARLES WATERTON

"A clove garden makes quite a picturesque sight. The trees vary from 10 to 16 feet in height, and are covered with leaves from their pointed tops almost to the ground."

C. DOMVILLE-FIFE

Cocoa is grown extensively in the West Indies, central and northern South America, and on the Guinea coast of Africa.

"We visited a cocoa estate. A cacao plantation, when the trees are in bloom, is as attractive a spectacle as an English orchard in May. The trees or shrubs grow from 16 to 18 feet high, and the fruit consists of a pod about 10 inches in length and nearly the same in circumference, containing five cells with a row of about twelve seeds in each, packed in a white sweetish pulp. The seeds or beans when extracted from the pod are fermented for six days in covered barrels, or under leaves—a process by which their bitter flavour is eliminated. When dried, by exposure to the sun, and polished, they are ready for the cocoa manufacturer, who reduces them to 'nibs' by roasting and crushing. The nibs contain fat which is extracted and utilised for making soap or candles. Then the finely powdered cocoa is ready."

G. MANINGTON

Sugar-cane is cultivated and exported, especially from Cuba and Java.

"The sugar-cane, which has a smooth shining stem 5 inches or more in circumference, rises from 7 to 10 feet, or even higher, and has broad, ribbed leaves. Crowned with an imposing plume, a large cane plantation presents the appearance of a vast field of pampas grass."

G. MANINGTON

"The air was sweet with the smell of caramel, and as we came onto the first field the prospect was enchanting : hill after rolling hill stiff with smiling cane, and here and there a palm tree standing like a sentinel over the sugar."

O. RUTTER

The chief grain crops are rice, manioc¹, maize and millet.

"The most important of the grain crops is rice. Just before the rains begin, in February and March, the seed is sown. When harvest time comes, and as the crop is ripening, the job is to keep the monkeys and birds off, even watching day and night."

W. H. INGRAMS

"Perhaps one of the most striking sights was the 'paddy' country under rice cultivation. From our height, the whole expanse of the land appeared to be inundated by irrigation water—all contained in minute, cell-like squares, that gave the effect of a mighty grid, stretching away to the mountains on our right. Even there the irrigation did not cease, but climbed up the mountain-sides in a system of stair-like terraces."

SIR ROSS SMITH

"Indigenous in the Guianas, cassava or manioc provides the native bread of vast areas in South America. To the outer world it makes its appearance in public as tapioca. Like other good things it has become widely distributed throughout the tropics and is now extensively cultivated in West Africa and Malaya."

C. W. WARDLAW

Other crops are ground-nuts,² arrowroot, cotton and tobacco.

"The ground-nut means everything to Gambia. The cultivation is done entirely by natives. There are no permanent plantations, big acreages of scientifically farmed land, but a haphazard spread of small patches of land is cultivated each year."

REX HARDINGE

"St. Vincent (West Indies) is now the land of arrowroot. The fine-grained starch is obtained from the tuberous under-

¹ Manioc is also known as cassava and yucca ; tapioca is obtained from it.

² Commonly known as peanuts or monkey-nuts ; their oil is used for making margarine, soap, etc.

ground parts of a plant which thrives on the volcanic soil of the hillsides. The preparation of the starch is simple, requiring only care and an abundance of fresh, pure water. The roots are first of all washed, crushed, and strained. The starch is allowed to settle in large flat shallow troughs and is then scooped out, dried, and packed for export.”

C. W. WARDLAW

“Cotton fields are a common sight in the Congo. A considerable amount is grown.”

HERMANN NORDEN

TROPICAL FORESTS AND SAVANNAH.—Areas situated to the north and south of the equatorial forest belt, while having similarly high temperatures, receive rain only in summer. Where the rainfall is very heavy there are dense forests, such as those on the coastlands of Peninsula India, in north-eastern India, northern Burma, south-western China, in the north and north-east of Australia, in the Chaco lowlands of central South America, and in southern Florida.

The trees of these regions, unlike those of the equatorial forests, are not always green. Some shed their leaves during the dry season to protect themselves from losing the moisture that would be given out by the leaves.

“The hot weather was upon us, and many of the trees stood naked in the white sunlight.”

F. KINGDON WARD

In the forests of India, Burma and the East Indies grow teak and sal trees, valuable for their timber.

“In Java we passed through many teak groves. The trees have a large leaf and a grayish bark, and will, if permitted, grow to an enormous size.”

JULIUS FLEISCHMANN

“Sal is the strongest and most important timber of northern India, and is chiefly used for building purposes. Its tall straight trunks are very characteristic.”

LADY HARTOG

Other trees are bamboo and sandal-wood.

“We saw beautiful bamboo-trees, growing in clusters like tufts of gigantic grass. It is difficult to imagine what China would do without this, her most useful tree. It furnishes food in the form of delicious young shoots, and chopsticks with which to eat them,

ropes, rafts, ladders, irrigation pipes, carrying poles, paper, ornamental carvings, and a thousand other articles."

R. L. BURDSALL AND A. B. EMMONS

"The sandal-wood is the produce of a small tree, which grows sparingly in the mountains of Timor, and many of the other islands in the Far East. The wood is of a fine yellow colour, and possesses a well-known delightful fragrance which is wonderfully permanent."

ALFRED RUSSEL WALLACE

The chief trees of the Chaco of South America are the quebracho and the yerba maté. From quebracho logs is obtained an extract used in tanning leather. The leaves of the yerba maté provide maté or Paraguay tea, a favourite drink in South America.

"Maté is an excellent beverage which deserves far greater popularity abroad."

K. G. GRUBB

"The greenish maté was bitter in taste and by no means pleasant, but was due in time to become my favourite beverage."

HARRY A. FRANCK*

Savannah or grasslands with scattered trees occur in the regions of less rainfall in tropical lands : in Africa, south-western and south-eastern Arabia, central India, Burma, Indo-China, southern China, the East Indies, northern Australia, the Brazilian Highlands, the Orinoco Basin, eastern Mexico, Yucatan, and the islands of the West Indies.

"The country has the character of a park. It is made up of wide lawns of grass, in which there stand clumps and isolated specimens of different forms of trees. These trees are not crowded together, but are grown just as they are in a piece of English parkland. There is no tangle, no forest, the scenery is delightful."

J. E. S. MOORE

"The ground was pleasantly undulating. The trees, belonging to a great variety of species, were not thrown together into an impenetrable thicket of forest, but formed into beautiful groups. Now and then a herd of cattle was seen dispersed over the rich pasturage grounds. Cotton fields interrupted the park-like scenery. We passed over extensive tobacco fields. Rich aro-

matic bushes were growing everywhere in the fields, affording nourishing food for bees, for whose use hives, formed of thick hollow logs, were fastened to the branches of great trees."

H. BARTH

"Probably the greater part of the Queenslander's 'open forest' would be described as grassland more or less lightly sprinkled with trees. Most of the trees are species of the great genus eucalyptus, which in Australia completely dominates arboreal society. The eucalypts do not bear edible fruit, but, usually at intervals of two or three years, they bear lavish crops of petal-less flowers. The blossoms, though little more than tufts of stamens, happen to be very rich in nectar, and when a big gum tree is in flower it is thronged from dawn to dark by flocks of honey-eating birds."

FRANCIS RATCLIFFE

Throughout India, Burma, Indo-China, South China, and the islands of the East Indies and West Indies the land is intensely cultivated and supports a large population. The crops are the same as in equatorial regions except for cocoa and rubber. Some of the products, notably coffee and cotton, grow better in these areas that have a long dry season, for the coffee-berries can be dried out of doors and the cotton is improved if the bolls can ripen and open during hot dry weather. India and south-eastern Asia produce large quantities of rice, cotton, tea and tobacco, and from the eastern margins of the Brazilian savannahs comes most of the world's coffee.

"As we neared Srinagar, flooded rice fields bordered the highway, and the whole district seemed to be under water."

E. FRENCH, M. CABLE, F. FRENCH

"We passed through a section of Sumatra in which is grown the world-famous Sumatra tobacco. Fields of it were planted on both sides of the road, some of it over six feet in height with the dark green colour indicative of healthy stock, while everywhere appeared the heavily thatched roofs of the barns built for the drying of the tobacco."

JULIUS FLEISCHMANN

"In Somaliland we saw the cultivation of large quantities of sugar-cane, and were told that these plantations supplied the

whole of the country with sugar. Cotton and bananas were also grown extensively."

E. W. POLSON NEWMAN

"The coffee blossom is small and white, and the pod is commonly a bright red, something like a cherry in appearance, with two beans inside. The leaves are of a dark green colour and shiny. The blossom has a pleasant perfume."

F. BENNETT

In addition, much wheat and barley are grown in these lands during the cool season, and there are certain exclusive products: jute in north-eastern India, sisal in East Africa, manila-hemp in the Philippines, henequen in Yucatan (Mexico).

Those parts of the tropical grasslands that are not agriculturally developed are used for cattle- and sheep-rearing: the savannahs of Africa, northern Australia and eastern Mexico, the llanos of Venezuela and the Orinoco Basin, and the campos of Brazil. But in these areas there are certain difficulties to contend with: the grass, except when newly sprung after the rains, tends to grow coarse and tall; during the dry season the question of providing sufficient drinking water for the flocks and herds becomes acute; in some districts insects (such as the tse-tse fly in Africa) cause disease amongst the animals. Northern Australia has most developed the rearing of cattle and sheep, and meat, wool and hides are exported. In Africa the people keep large herds of cattle for their own use and export the hides. In South America ranching is being developed, especially in the campos of Brazil.

TROPICAL ARID LANDS.—To the north and south of the tropical grasslands lie areas where the rainfall is so scanty and uncertain that there is little vegetation. These are the tropical deserts: the Sahara (northern Africa), eastern Palestine, parts of Transjordan, Syria and Iraq, the interior of Arabia, the south coastlands of Iran, the Thar of north-west India, the Simpson desert of Australia, the Colorado-Sonoran desert of south-western United States and northern Mexico, the Peru-Atacama desert of western South America.

Deserts are not featureless sandy plains where nothing grows. They contain hills, valleys and plateaus; barren expanses of

sand, gravel and rocks alternate with areas covered with short grass, thorny shrubs and cactus plants.

“The great Sahara Desert is relieved by some very remarkable mountain groups, chief of which are Air, Ahaggar and Tibesti—each in extent as large as the whole of England, and towering majestically to altitudes of 6,000 to 10,000 feet.” A. BUCHANAN

“The Arizona region (south-western United States) is, on the whole, an elevated tableland. The northern and eastern parts, however, and some other spots, are decidedly mountainous. Having mounted the tableland, if you travel from the east, you will find large tracts of the country which are flat, or nearly so. It is in this district that you will come upon the desert. There is not even a moss or a lichen to be discovered. There are no insects even here, no flies, no mosquitoes. The air is so clear that rocks ten miles off appear but a mile distant. These desert spots are only met with at intervals.” PAUL FOUNTAIN*

“In north-west Australia you can see a foreshore dried like crocodile skin, some gnarled old baobab trees, and sand—tan, grey, and coppery bronze—whose glare makes you screw up your eyes. No fruit grows in Derby, no vegetables. Iron is hot to the touch even when the sun is off it, and the white ant eats wood to powder.” THOMAS WOOD

“It is very singular to pass a highly cultivated mountain-side, or coffee patch in a valley, and after an hour or two’s travel to find oneself in a horrible desert of sand, without even a blade of grass visible; but it is a frequent experience in the southern and north-eastern districts of the Peruvian Andes.” PAUL FOUNTAIN

“There are deserts and deserts. There is the ‘wilderness’ occupied by drought-resisting shrub and occasional grass where nomads wander with their camels; or more barren and lifeless still, but dotted with wells which provide a permanent subsistence for a small settled population. There is nothing terrible about the wilderness. This kind of country occupies much of the world; it exists in every continent. Of such a type is all the country east of the Nile in Egypt; it stretches away across Sinai, across Arabia to Persia and beyond. Very different is the great lifeless

desert westward across North Africa from the western banks of the Nile."

RALPH A. BAGNOLD

The grass and flowers which grow thinly over large areas of the deserts die away during the driest periods, but spring up again if there is a shower of rain.

"After the rains there came a transformation of the country that was startling in its rapidity. The trees and plants in the thick scrub had looked shrivelled and thirsty, and the dry leaves and stiffened mosses had cracked beneath our feet, but soon the dripping moisture gave life to everything. Buds shot forth and flowers formed and bloomed with such rapidity that it looked as if the whole of Nature were running a race with time. Following the bursting of the blossoms came the hatching of gaudy caterpillars, and soon thousands of brilliant butterflies, intoxicated with the subtle scent of flowers, flirted in the sunbeams that peeped through the loose-leaved foliage."

SIR G. H. WILKINS

Certain plants can withstand the drought. They have tiny waxed leaves so as to give out little moisture, roots going deep into the ground, and sometimes store water in their leaves and stems. Many are thorny, as a protection against animals, and most have thick, gummy sap.

"Beyond lies the scrub jungle. It is a study in thorns. Each bush rivals its neighbour. The acacia takes the lead, with a straight thorn three or four inches in length. Other bushes grow a combination of the straight and the hooked—or wait-a-bit—thorn, as though to inflict a wound however approached. From below—to meet the thorn bushes from above—springs the spiked aloe, with a blade like a triangular bayonet, tipped with a hardened spike, which will penetrate even the strongest shoe-leather."

F. D. LUGARD

"The immediate neighbourhood was a perfect exhibition of gum-arabic bearing mimosas. At this season the gum was in perfection, and the finest quality was now before us in beautiful amber-coloured masses upon the stems and branches, varying from the size of a nutmeg to that of an orange. This gum, although as hard as ice on the exterior, was limpid in the centre,

resembling melted amber, and as clear as though refined by some artificial process. The trees were perfectly denuded of leaves from the extreme drought, and the beautiful balls of frosted yellow gum recalled the idea of the precious jewels upon the trees in the garden of the wonderful lamp of the 'Arabian Nights'. This gum was exceedingly sweet and pleasant to the taste."

SIR SAMUEL BAKER

"In the Californian desert huge ghostly shadows of cacti in a hundred forms surround you in the moonlight. Not a movement of any kind anywhere. Not a sound. Even if the wind is blowing, still the gigantic growths will be motionless—there are no leaves to flutter delicately in the desert. No animal life, either, for the only denizens of the cactus forest are deer and peccary, with—rarely—the cougar, and all of these are more afraid of you than you are of them. They will not come anywhere near a camp, day or night."

ROBERT FROTHINGHAM

"Men have perished of thirst amongst groves of cacti plants. Had they possessed a 'little learning', one slash of a knife on the nearest trunk would have furnished them with several quarts of excellent fluid, and saved their lives."

PAUL FOUNTAIN

Some varieties of cactus are cultivated and their fibres used for rope-making.

In certain parts of the desert there is a permanent supply of water, and these regions, which may be of any size, are known as oases. The water supply is sometimes due to a river running through the desert; for example, the River Nile transforms Egypt into a huge oasis in the Sahara.

"It must be remembered that, although Egypt is nearly 800 miles in length, its average (arable) breadth is only 10 or 12, of which the river is the great feature, the centre and source of fertility and wealth."

SAMUEL MANNING

Iraq would be a desert region were it not for the Rivers Tigris and Euphrates.

"Iraq is a long thin strip of riverine land, with the untamed desert on the one hand and the uncivilised mountains on the other."

A. J. REYNOLDS



GATHERING AND SORTING DATES IN EGYPT (page 200)



Courtesy of the Peruvian Corporation, Ltd.
CUTTING CACTUS IN PERU (page 207)

The many small rivers that flow from the snow-capped Andes across the Peruvian desert have given rise to more than fifty small oases.

Sometimes the oases are due to ground water underneath the desert which can be obtained by digging wells. This is the case in Australia, in parts of the Sahara, and over most of central Arabia.

“Each garden is watered from a well within the grounds.”

G. WYMAN BURY

In hilly regions the ground water issues forth as springs. This is the cause of the oases of the Central Sahara and the Colorado desert.

“At Indio and Coachella in the Colorado desert are hot springs and groves of date-palms and figs. The oasis is rapidly becoming a great date-producing centre.”

LE ROY JEFFERS

Other oases are man-made, due to engineering feats. The Imperial Valley, near the mouth of the Colorado River in the Colorado-Sonoran desert, is richly productive owing to irrigation schemes. Much of the Thar desert of India has been reclaimed since the building of a barrage on the River Indus.

“The Sukkur Barrage in Sind, completed in 1931, is one of the largest of its kind in the world. Here a dam one mile long raises the level of the Indus 16 feet, and so provides irrigation for 5½ million acres.”

LADY HARTOG

The land of the oases is intensely cultivated. The most important product is the date-palm.

“The date-tree consists of a simple stem or trunk about 15 to 30 feet high, without a branch, and crowned at the summit by a cluster of leaves or ‘palms’ that droop somewhat in the shape of a huge umbrella.”

SAMUEL M. ZWEMER

“By the side of the streams innumerable palm-groves grow—in fact, dates form the staple food of the people. And out of the date-tree they get branches for their hedges, stems for their roofs, the leaf provides them with their sleeping-mats, and, when beaten on stones, with fibre, with which they are exceedingly clever in making ropes.”

THEODORE BENT

In the Sudan grow many dom-palms, the nuts of which provide vegetable ivory.

"During the march we came on several palms, with clusters of hard fruit about the size of apples growing at the top. I tasted one of them, and it resembled very dry gingerbread as near as anything; it ought to be called a bread-fruit, but is called a dom-palm. The natives are said to live on it."

FREDERICK LORT PHILLIPS

Various crops are grown in the oases, such as wheat, rice, millet, maize, cotton, sugar-cane, tobacco and fruits.

"In Egypt fields of maize, millet, cotton and sugar-cane line the river-banks, and produce three harvests in the year, with little toil to the cultivator, beyond that required for raising water from the river for purposes of irrigation."

SAMUEL MANNING

Many sheep, cattle, goats, horses, and especially camels are reared. They are driven from place to place as they eat up the scanty pasturage.

"The camel is a domestic animal in the full sense of the word. All that can be obtained from the animal is of value. Milk, excellent hair for tents, ropes, shawls and coarser fabric are obtained from the living animal; and flesh-food, leather, bones and other useful substances from the dead."

SAMUEL M. ZWEMER

"In children's books, the Bactrian two-humped animal figures as the camel, on what authority I have never been able to discover, whereas the pride of Arabia and Africa and the steed of the Camel Corps has but one hump."

R. E. CHEESMAN

ANIMALS OF TROPICAL LANDS

The equatorial forests are not as rich in animal life as might be expected from the fact that people are few and plants so abundant. The larger animals find the dense forests as difficult to traverse as do human beings. Even the African elephant, strong enough to break down the undergrowth and smaller trees that lie in his path, prefers to stay near the edges of the forest.

The chief creatures present therefore are those that climb or fly and make their homes in the trees, such as monkeys, birds, bats and insects ; those that crawl through the dense vegetation, such as snakes ; and those that live in the rivers and streams, such as crocodiles or alligators.

“ Now and then troops of monkeys bounded with prodigious leaps through the branches, others swinging by long tails a hundred feet above our heads, and with marvellous agility hurling their tiny bodies through the air before burying themselves out of sight in the leafy depths. As for birds, they made clatter enough overhead, but we were in the basement, and they were on the roof of a fifteen-storey house. They could not be seen at all though their whistlings, warblings, screamings and hootings were heard everywhere. There were parrots, ibis, touracos, parroquets, sunbirds, swifts, finches, shrikes, whip-poor-wills, hoopoes, owls, guinea fowl, blackbirds, weavers, kingfishers, divers, fish eagles, kites, wagtails, bee-eaters, pipits, sandpipers, cockatoos, hornbills, jays, barbets, woodpeckers, pigeons, and unknown minute tribes, and millions of large and small bats. Insects would require a whole book.” SIR HENRY M. STANLEY

“ There is never any respite from things that bite and sting. Some attack because it is going to rain, or because it is raining, or has rained, or won't rain. Some because it is dark, others because it is light. So they succeed one another regularly in shifts and there are no interludes.” EVELYN CHEESEMAN

“ Crocodiles were exceedingly numerous both in and out of water ; wherever a sandy beach invited them to bask, several monsters were to be seen, like trunks of trees, lying in the sun.”

SIR SAMUEL BAKER*

The tropical forests and savannahs are richer in animal life than other parts of the world. Even in India, despite its agricultural and industrial development and large population, animals, birds, reptiles and insects abound in the remoter parts.

“ The forests are the favourite haunts of the big game of India, more especially the damp forests of the Western Ghats, of the Terai, and of Assam, still the home of the wild elephant, the

rhinoceros and the bison. The only lions to be found in India are a few in the north-west. India's characteristic beast of prey is the tiger. Far more common than the tiger is the leopard or panther, which is just as dangerous. The black or sloth bear is fairly common wherever there are rocky hills and forests, but is, as a rule, harmless to man, living on ants, honey and fruit. Crocodiles haunt nearly all Indian rivers. Sometimes they bask in the sun near the water's edge ; sometimes they lie with just the head above the surface of the water, motionless as a piece of wood, but at the very slightest sound they disappear."

LADY HARTOG

"The deadliest guardians of the Burmese jungle are not tigers and vipers, deadly as they are, but battalions of leeches, blister flies, ticks, mosquitoes, sand-flies, and horse-flies, all avid bloodsuckers, whose bites cause fevers." F. KINGDON WARD**

The vast savannahs of Africa, as yet largely undeveloped and under-populated, are the world's chief game reserve. Monkeys, birds, insects and snakes abound. Elephants, giraffes, rhinoceros, zebras and antelopes feed on grass and trees. Lions, tigers and leopards prey on the smaller animals, and are themselves followed up by the carrion eaters such as hyenas, jackals and vultures. Crocodiles and hippopotamus live in the streams.

"Can you imagine a parched brown plain rolling off to a deep blue line against a turquoise sky, and in the foreground a group of zebras drinking from a pool that is gold in the afternoon sun—perfect little horses, elegantly striped in black and white, smooth and glossy as if they had been curried, quick and graceful in movement as an Arab mare? Can you imagine a herd of giraffes feeding among the grey-green thorny mimosas, animals 18 feet tall, their deep burnt-orange hides covered with an irregular network of white lines? Can you imagine ugly rhinos snorting like great angry pigs in the night just outside your hut of stones and thornbush? You look out and see them, big as motor-cars, their grey hides turned to white by the moon, and their horns looking even wickeder than they look in daytime. Can you imagine beautiful fawn-coloured gazelles, with great soft eyes and

long, gracefully curved ringed horns, stepping lightly down to drink at a water-hole? Can you imagine waiting for King Lion himself to come? Can you imagine yourself unexpectedly face to face with a great African elephant whose tusks are longer than a man is tall? Can you imagine, day and night, a constant procession of animals from jack-rabbits to fierce, black buffaloes? Everywhere you look you see them. To ride in a railway train is like visiting a zoological garden.”

MARTIN JOHNSON

“In all directions from our camp we could see herds of game grazing. Flocks of fowl flew up and down the water-course, huge crocodiles leered evilly at us as they floated like logs on the oily water, and now and then the head of a mud-turtle rose like a ghost from below, without even a ripple, drew a long hissing breath, and as silently vanished. After an eventful night, during which leopards coughed, lions roared, hyenas dashed into camp and bolted with my best waterbuck head, we all turned out early.”

EWART S. GROGAN AND ARTHUR H. SHARP

“When a lion is met in the daytime, a circumstance by no means infrequent to travellers in these parts, if preconceived notions do not lead them to expect something very ‘noble’ or ‘majestic’, they will see merely an animal somewhat larger than the biggest dog they ever saw, and partaking very strongly of the canine features. When encountered in the daytime, the lion stands a second or two gazing, then turns slowly round, and walks as slowly away for a dozen paces, looking over his shoulder; then begins to trot, and, when he thinks himself out of sight, bounds off like a greyhound. By day there is not, as a rule, the smallest danger of lions which are not molested attacking man, nor even on a clear moonlight night. When a lion is very hungry, and lying in wait, the sight of an animal may make him commence stalking it. In one case a man, while stealthily crawling towards a rhinoceros, happened to glance behind him, and found to his horror a lion *stalking him*; he only escaped by springing up a tree like a cat.”

DAVID LIVINGSTONE

“I saw in the bottom of the ravine, wading and rolling in the mud, a herd of five elephants. I remembered, hastily, that your

one chance when charged by several elephants is to dodge them round trees, working down wind all the time, until they lose smell and sight of you, then to lie quiet for a time and go home. It was evident from the utter unconcern of these monsters that I was down wind now, so I had only to attend to dodging, and I promptly dodged round a tree, and lay down. Seeing they still displayed no emotion on my account, and fascinated by the novelty of the scene, I crept forward from one tree to another, until I was close enough to have hit the nearest one with a stone, and spats of mud, which they sent flying with their stamping and wallowing came flap, flap among the bushes covering me. One big fellow had a nice pair of 40 lbs. or so tusks on him, singularly straight, and another had one big curved tusk and one broken one. Some of them lay right down like pigs in the deeper part of the swamp, some drew up trunkfuls of water and syringed themselves and each other, and every one of them indulged in a good rub against a tree. Presently when they had had enough of it they all strolled off up wind, through the bush in Indian file. When they had gone I rose up and turned round to find my men."

MARY KINGSLEY

In India, Burma and south-eastern Asia, elephants are domesticated. They are noted for their intelligence and gentleness as well as their great strength. They are employed as riding animals and for certain heavy work such as moving weighty teak logs in forested areas.

Australia contains animals peculiar to itself, among them flying-foxes and kangaroos.

"The great mangrove swamps of Tropical Queensland provide shelter for a very large part of the vast flying-fox population. Flying-foxes are large bats with a body nearly as big as that of a cat and a wingspread of over 5 feet. For all their great size, however, flying-foxes are harmless enough, for they are exclusively vegetarian and subsist mainly on fruit."

FRANCIS RATCLIFFE

"I screened myself behind the trees. Presently a rustling by my side attracted my attention, and six beautifully furred kangaroos came hopping slowly to the water. Sitting perfectly



Courtesy of the Imperial Institute
DOMESTICATED ELEPHANTS (page 214)



Courtesy of the High Commissioner for Southern Rhodesia
A GIRAFFE (page 212)

still, I waited until they came within 20 yards from where I sat. Keen to begin my work of collecting specimens, I raised my gun, but as I did so the biggest of the kangaroos turned towards me, and a little 'joey' peeped out from its mother's pouch. Anxious as I was to begin my work, I lowered my gun and watched the curious creatures with admiration. I could not shoot these trustful things, and for twenty minutes I watched them drink and chase each other round the water-hole. The ducks came back and settled in the water and some plovers screeched and ran around the banks; but, while the kangaroos still played my gun was silent."

SIR G. H. WILKINS

"One of the most striking features of northern Australia—and, indeed, right away north throughout wide stretches of the Northern Territory—is the enormous number and size of the white-ant hills. There are different kinds of these, varying in height from a foot or two to as much as twenty feet. They vary not only in size but in shape. Some are simply flat slabs—those made by the so-called meridian ant; others are constructed of a number of spherical masses, looking like bubbles of earth; others are bluntly rounded; but the great majority are conical. Another very striking feature of the ant hills is their variation in colour, which, of course, depends on the nature of the soil and that again on the rock formation out of which the surface of the country is formed. In some parts they are dark brown or almost black, in others they are red, and in others yellow. You never by any chance see a white ant in the open, because it is a most helpless insect, and everywhere and always it works in the dark."

B. SPENCER AND F. J. GILLEN

"Nature's freakish things are here too—stick insects a foot in length looking like, well, just a stick. A grasshopper as large as a banana and as fat. Beetles and spiders that give you a shiver down the spine. One insect, a black evil-looking fellow some four inches long, had 'feelers' streaking out at right angles to its head no less than eighteen inches across, and jaws that could nip your finger to the bone. I felt as if I never wanted to sleep again while in the Far North."

CHARLES H. HOLMES

“The emu is one of Australia’s vanishing creatures. To me it looked like a miniature ostrich.”

CHERRY KEARTON

The tropical forests and grasslands of the New World contain little animal life other than birds (including the rhea or South American ostrich), insects and snakes. Among the comparatively few animals are jaguars and pumas and occasional herds of wild cattle. Like other tropical areas, South America sometimes suffers from plagues of locusts which destroy the crops, stripping the plants bare of leaves and buds.

“On coming down from the mountains I walked into a cloud of locusts. To start with I heard a noise like a waterfall, and on looking up the whole sky appeared dotted with flakes, like a very heavy snowstorm ; it extended in every direction ; a little farther and the ground was hidden by them. A few rose, and those few were so thick one could hardly see in front of one.”

FREDERICK LORT PHILLIPS

The chief wild animals of the arid lands are gazelles, wild asses and hyenas.

“A herd of gazelles provides a spectacle never to be forgotten when outlined on the top of a ridge against the blue sky or seen sometimes by the score, flying across the desert at an incredible speed, like a cloud of swallows flying low.”

B. K. DE PROROK

“The wild ass is either of an ashy grey or a dark reddish-brown. They have a quick walk and continue this pace for many hours, and are of great value in crossing mountain passes, the concavity of the hoof allowing them to ascend precipitous paths with ease. Though short in the legs and apparently not intended for speed, the wild ass can rarely, if ever, be overtaken by a horseman.”

S. B. MILES

“The hyena, when full grown, is nearly 6 feet from nose to the tip of the tail. The voice of the hyena is extraordinary, on account of the variety of its sound ; the snarling, hideous, laughing noise it utters round a carcass is only made when it is annoyed or excited.”

SIR JOHN BLAND-SUTTON

Travellers seem to be agreed that wild animals are not as dangerous to man as might be supposed.

"Time and experience have convinced me that there is not much danger in roving amongst snakes and wild beasts, provided only that you have self command. You must never approach them abruptly ; if so, you are sure to pay for your rashness, because the idea of self-defence is predominant in every animal ; and thus the snake, to defend himself from what he considers an attack upon him, makes the intruder feel the deadly effect of his poisonous fangs ; the jaguar flies at you and knocks you senseless with a stroke of his paw : whereas, if you had not come upon him too suddenly, it is ten to one but that he had retired, in lieu of disputing the path with you."

CHARLES WATERTON

However, as the lands are being settled and farmed, the animals are gradually becoming less numerous.

"For as soon as you have settlers and farms, the elephant, with the rhinoceros and the hippopotamus, must be banished. The mammoths belong to an age when man had not yet become the chief of the animals. They do not accept his terms. They refuse to be domesticated. They destroy crops and break fences."

MARTIN JOHNSON

EXERCISES

1. State the chief products obtained from the equatorial forests.
2. Make a list of the chief crops grown in tropical regions, mentioning the countries where they are produced for export.
3. What are : oasis, cactus, rubber, quebracho, mangrove, copra, crocodile, locust?
4. Explain why : (a) the equatorial forests are never leafless, (b) there are few large animals in equatorial forests, (c) there are so many wild animals in the African savannahs.
5. Rewrite, filling in the missing words :

The tropics contain three vegetation zones : the — —, the tropical — and —, and the tropical — —. Lands in equatorial regions have constant — temperatures and — rain throughout — —, and therefore the natural vegetation is dense —. The

areas north and south of the equatorial region have rain — in the — season. Here the lands are covered with tall — and occasional —, but the areas where rainfall is very — are forested. Lands north and south of these savannahs and tropical forests have — rainfall, and here are situated the world's greatest —. These areas are barren only because they lack —; wherever water is available from rivers (as in —, — and —), from wells (as in — and —), and from irrigation schemes (as in — — —, — — — — and — —), the land produces many crops, among them —, —, —, — and —.

COMPOSITION

On a Tropical Island.

LOCAL STUDY

Prepare a list of the goods from tropical lands used in your home or sold in local shops.

HANDWORK

Make a collection of pictures of tropical animals.

DEBATE

It is pleasanter to live in tropical regions than anywhere else.

SRI PRATAP COLLEGE
SRINAGAR
LIBRARY

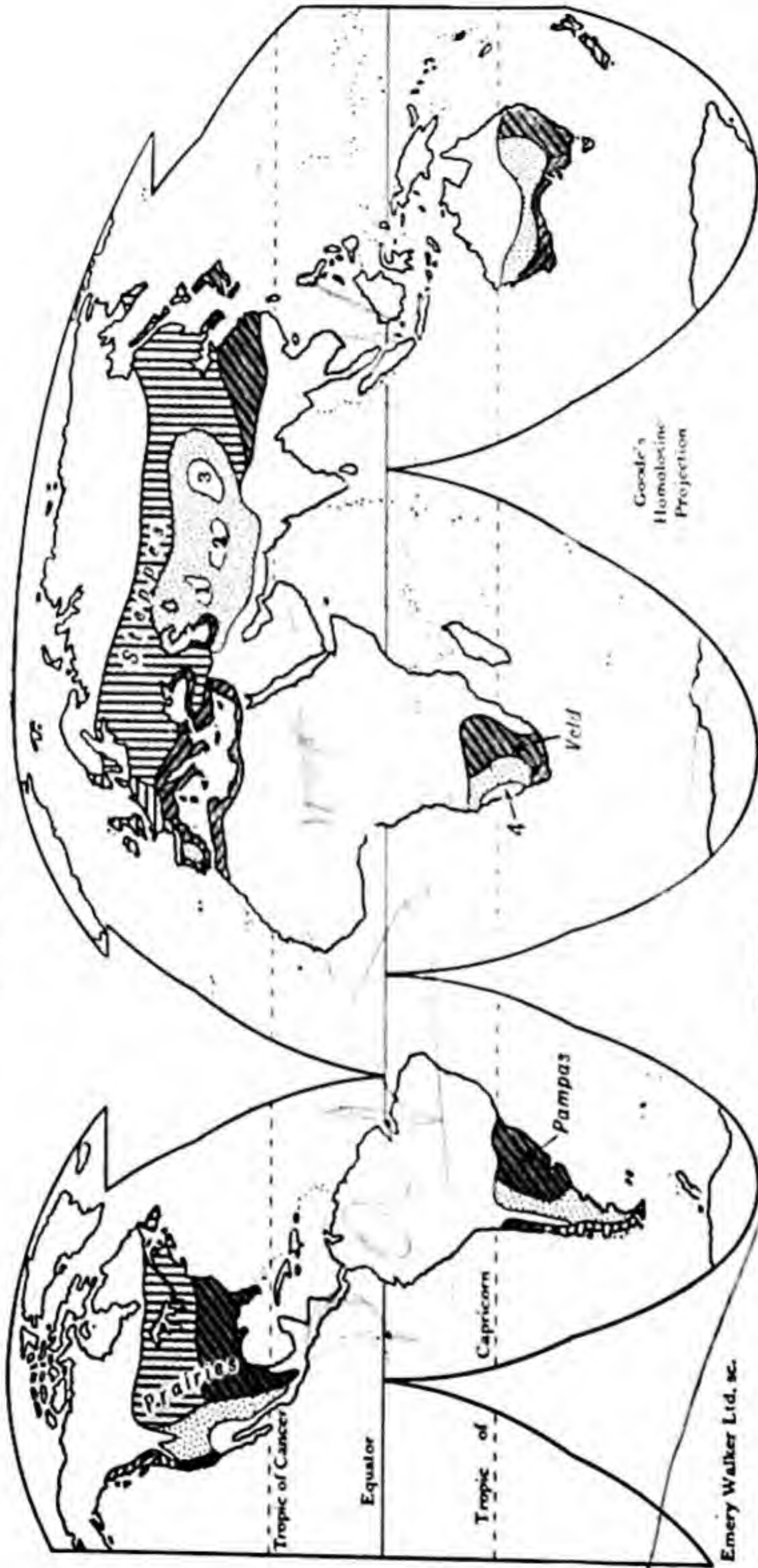
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CHAPTER EIGHT

THE TEMPERATE LANDS



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|--|-------------------------------|--|--|--|-------------------------------|
| | Warm Temperate Western | | Cool Temperate Eastern and Interior | | 2 = Takla makan desert |
| | " " " | | Temperate Arid Lands | | 3 = Gobi desert |
| | Cool | | 1 = Kara and Kysyl hum desert | | 4 = Namib desert |

CHAPTER EIGHT

THE TEMPERATE LANDS

VEGETATION

THE WARM-TEMPERATE WESTERN OR MEDITERRANEAN LANDS have hot dry summers and mild rainy winters. In summer they are within the high pressure belt of the Horse Latitudes, and so enjoy warm, dry, cloudless weather. In winter, when the high pressure belt moves equatorwards, they are under the influence of the rain-bearing westerly winds. Lands with this type of climate are the countries bordering the Mediterranean Sea, the southern shores of the Black and Caspian Seas, south-western South Africa, south-western and southern Australia, central Chile, and the coastlands of California.

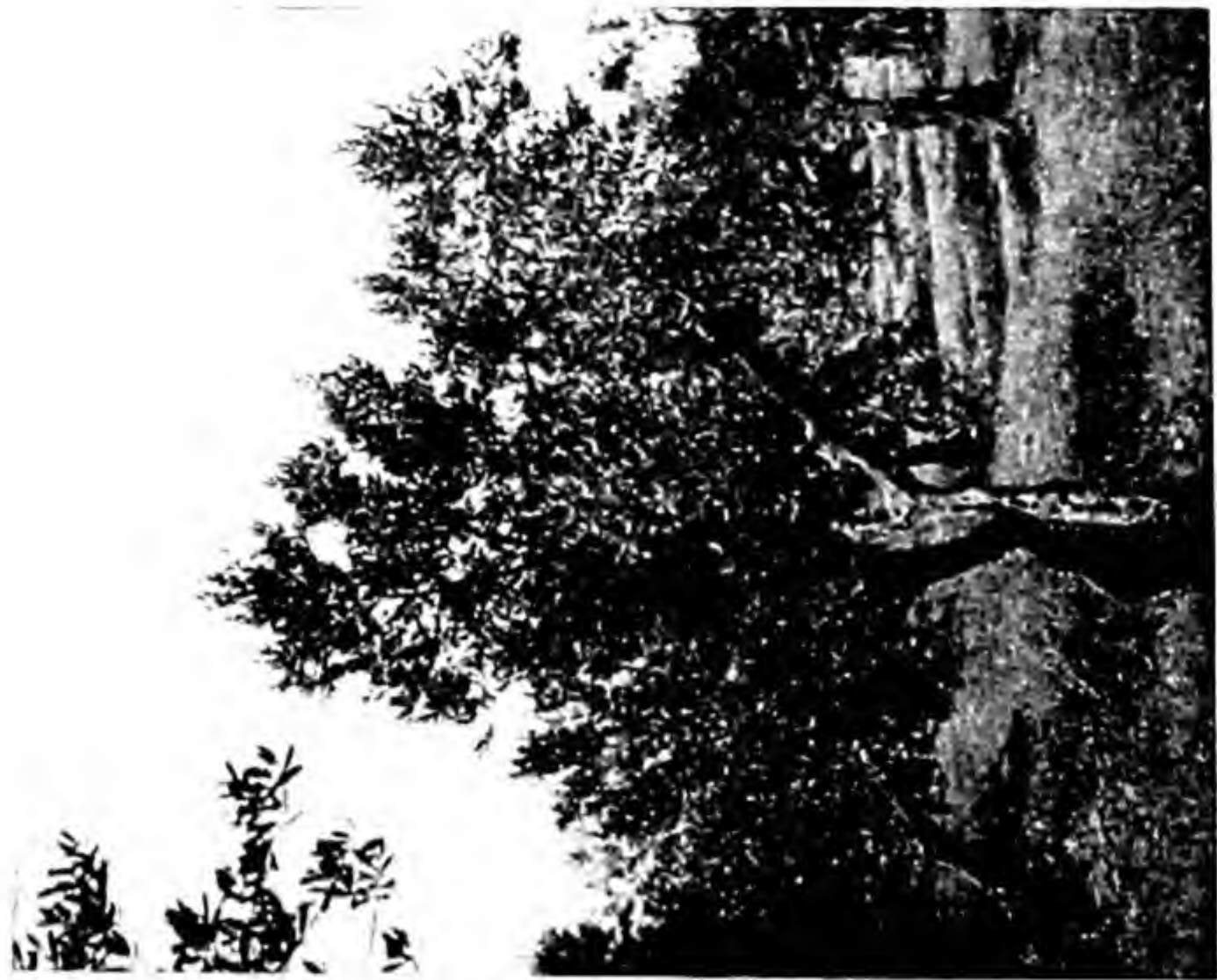
In these areas forests are few, for rainfall is barely sufficient. The trees are mostly evergreens, and to protect themselves against a long rainless summer, have small leathery leaves, deep roots and, in some cases, protective bark. The chief varieties are olive, myrtle, evergreen-oak, cork-oak, chestnut, jarrah and acacia.

Olive-trees and chestnut-trees are of great importance in the countries round the Mediterranean Sea. Olives are eaten locally and exported, while the oil extracted from them is used for cooking, sardine-packing, and in the making of medicine, margarine and soap. Quantities of chestnuts are also eaten and exported. Spain, Portugal and Algeria have the monopoly of supplying the world with cork ; the bark of the cork-oak is so carefully stripped that the tree suffers no damage in the process. The jarrah of Australia provides hard wood used for decorative purposes, furniture and paving blocks.

" Timber is stacked at Yarloop, Western Australia, in every shape from great logs to butter boards. I saw railway sleepers,



Courtesy of the Italian State Tourist Department
GRAPES (page 225)



Courtesy of the Italian State Tourist Department
OLIVE TREES (page 224)

and paving blocks, and weather-boarding, and planks piled criss-cross in stacks so high that they looked like a street of modern flats. And there was a row of forty-foot linings, for some tube station in London. But the thing that took my eye was jarrah panelling. It is not unlike mahogany ; a deep rich red, with a fine grain."

THOMAS WOOD

Grass does not flourish in these regions of dry summers. Its place is taken by a ground vegetation consisting of sweet-smelling shrubs and herbs. This type of vegetation is known as *maquis* around the Mediterranean, *cape scrub* in South Africa, *chapparal* in California, and *mallee* in Australia.

"The limestone hills of the Cevennes (France) are overgrown with aromatic herbs, mint, marjoram, thyme, sage, lavender, rosemary. The shrubs and trees are for the most part evergreens, where the chestnuts do not spread in forests, or the mulberry is not cultivated for silkworm culture."

S. BARING-GOULD

"I have taken several long walks in the country near Valparaiso (Chile). The vegetation here has a peculiar aspect ; this is owing to the number and variety of bushes which seem to supply the place of plants ; many of them bear very pretty flowers, and very commonly the whole shrub has a strong resinous or aromatic smell. In climbing amongst the hills one's hands, and even clothes, become strongly scented."

CHARLES DARWIN

Crops grow well in these lands of mild winters, providing, like the grape-vine with its deep roots, they can withstand the dry summer, otherwise a certain amount of irrigation is necessary. Much wheat and barley are grown, as well as vegetables and fruits ; these last are among the chief exports. Oranges, lemons, grapefruit, figs and peaches are exported fresh and canned, grapes are produced for wine making, and dried in the sunshine to provide raisins, sultanas and currants.

"It was harvest time near Tripoli (Libya). Fields of barley, wheat and other grains stood red and ripe awaiting the reaper. Well-tended fruit trees, laden with oranges and other marketable fruits, were being garnered, and far-flung vineyards hung heavy with purple grapes."

DUGALD CAMPBELL

Some cattle are kept, also goats, donkeys and mules. Many sheep are reared in Australia, and ostriches in South Africa. In most cases the livestock have to be moved farther afield to new pasturage or taken to nearby mountain pastures during the summer.

"As I neared the little village I encountered herds of goats being driven up to the pastures vacated by the winter snows."

F. S. SMYTHE

"The South African plains are sparsely covered with a growth of low scrub. The sheep, goats and ostriches of the Cape farmer flourish exceedingly ; and were it not for the ever present difficulty and danger of the lack of water, pastoral farming would be a calling free from care."

H. A. BRYDEN

THE WARM-TEMPERATE EASTERN LANDS have hot summers, cool winters, and rain principally in summer from inblowing south-east trades or monsoon winds, but also some in winter from the westerlies. The chief areas in this zone are the southern United States, the Mexican Plateau, southern Brazil, Uruguay, southern Paraguay, northern and central Argentina, south-eastern South Africa, central China, southern Chosen, Japan, south-eastern Australia, and North Island (New Zealand).

Near the coasts, where rainfall is heaviest, there are forests of cypress, laurel, evergreen oak, chestnut, maple and conifer. In addition, bamboo and camphor trees grow in China and Japan, yerba maté in South America, kauri and tree-ferns in New Zealand, and tree-ferns and eucalypts in Australia.

"The trees of Australia nearly all belong to one family (the foliage is scanty and of a rather peculiar light green tint—it is not periodically shed), and have the surface of their leaves placed in a vertical instead of, as in Europe, a horizontal position. This fact and their scantiness makes the woods light and shadowless ; although under the scorching sun of the summer this is a loss of comfort, it is of importance to the farmer, as it allows grass to grow where it otherwise could not. The greater number of the trees, with the exception of some of the Blue Gums, do not attain



AUSTRALIAN SHEEP (page 226)

Courtesy of the Canadian Paci



Courtesy of the Argentine Ministry of Agriculture
HARVESTING WHEAT IN JANUARY (page 228)

a large size, but they grow tall and tolerably straight and stand well apart. It is singular that the bark of some kinds annually falls, or hangs dead in long shreds, which swing about with the wind ; and hence the woods appear desolate and untidy."

CHARLES DARWIN

The forests merge into grasslands known as *pampas* in South America, *veld* in South Africa, and *downs* in Australia. Crops flourish in these districts of long warm rainy summers and, in Japan and China, support a very large population, and in the other areas provide goods for export. The chief products are rice, maize, wheat, barley, sugar-cane, tobacco, cotton, oranges, and in eastern Asia mulberry-trees for the feeding of silkworms.

"The Cheng-tu plain, with its three or four crops a year, is the richest and most populous district in the whole of China. This extraordinarily productive plain supports a population estimated at no less than 4,000,000. Among the crops are rice, wheat, tea, tobacco, maize, the opium-poppy, and the yellow rape that turned hundreds of acres of land into seas of bright gold."

R. F. JOHNSTON

"The Japanese fields are surrounded with hedges of mulberry trees, with broad shining leaves, which add immensely to the general appearance of the country. The mulberry trees are in leaf just as the worms are hatched from the eggs which have been carefully kept during the winter, and, when once hatched, the grubs must be carefully and constantly tended and fed. Piles of shallow bamboo crates are piled up on stands in the great upstairs apartment, and in any other quiet place that is available, and here the grubs are allowed to feed to their hearts' content on the broad mulberry leaves which are constantly being brought in fresh and crisp from the fields. Great care must be taken during this period, for the silkworms are easily disturbed, and the country people say that if they hear bad words spoken, or words of ill omen, they will shrivel up and die. Silence therefore is observed in all rooms where there are silkworms. When the grubs have done eating, they go to sleep in the cocoons which they have spun for themselves, and a little later, when the right

time comes, the cocoons are taken and the silk thread is spun from them.”

ARTHUR LLOYD

Cattle, sheep, horses, ostriches, pigs and poultry are reared in certain areas. Large quantities of beef, mutton, hides and wool are supplied to the world by the warm temperate eastern lands of South America, Australia and South Africa. Dairy-farming and the exporting of butter are of importance in Australia and New Zealand. In the southern United States pig- and poultry-keeping and dairy-farming are extensively carried on. In China and Japan only pigs and poultry are reared, as the population is so dense that the land cannot be left under grass, but has to be cultivated for food crops.

THE COOL-TEMPERATE WESTERN OR OCEANIC LANDS are always under the influence of the westerlies, and so have abundant rain at all seasons; and, since they border the oceans across which the prevailing winds blow, their winters are mild and summers cool. The chief areas within this region are north-western Europe (including the British Isles), north-western North America (Oregon and Washington in the United States, Vancouver Island and British Columbia in Canada), southern Chile, Tasmania, and South Island (New Zealand).

These districts contain extensive forests of oak, ash, elm, beech, fir, pine, cedar and spruce, except in north-western Europe where they have been largely cut down to make room for the dense population. Lumbering is an important industry in western North America (where the chief timber-tree is the Douglas fir) and in New Zealand (where there is much kauri pine).

“The kauri grows thick, high, and proud, and many kauris together are like the temple of Solomon. The kauri exudes gum, which is used in varnish-making.”

DONALD COWIE

“The lumbering business is naturally one of great import in a country famous not only for the density of its forests, but for the size of its trees. The Douglas fir is the greatest of these, and while occasionally reaching 300 feet in height, will quite commonly be more than half that altitude, with a diameter of



Courtesy of the Agent General for Queensland
CATTLE PASTURES, QUEENSLAND (page 229)



Courtesy of the High Commissioner for Southern Rhodesia
RHODESIAN OSTRICHES (page 229)

5 or 6 feet. The yellow and red cedar is almost equally plentiful, and yet more valuable." A. G. BRADLEY

The beech forests of Chile are still almost untouched.

"The view was imposing—the whole wood is composed of the antarctic beech. This tree is an evergreen, but the tint of the foliage is brownish yellow. The trees, though not high, are of considerable thickness." CHARLES DARWIN

"When seen in such masses as these, surely the beauty of the giant evergreen glades exceeds that of any other timber. Here and there, where the glades are more open, cattle are grazing in the shade of the trees." W. H. KOEBEL

In these oceanic lands crops do not grow well except in the drier parts, for example eastern England, central France, the sheltered valleys of western North America, and of South Island, New Zealand. The chief crops are rye, oats, barley, potatoes, sugar-beet, wheat, and fruits such as apples, pears, plums and cherries.

Grass grows excellently, furnishing splendid pasture. Dairy-farming is carried on and many cattle, horses, sheep and pigs are reared.

"Central Ireland is almost literally enmeshed in a network of small fields which provide some of the best grazing that the world can offer. It is a grass country through and through, which the softness of the climate and its prevailing moisture invest with a delicious greenness that has become proverbial." MICHAEL FLOYD

"The Canterbury Plains of New Zealand are one great sheep-run, open, almost flat, and upon which you lose all sense of size. At the mountain foot they are covered with tall, coarse, native grass, and are dry, like the Kansas prairie; about Christchurch, the English clover and English grasses have usurped the soil, and all is fresh and green." SIR CHARLES WENTWORTH DILKE

THE COOL-TEMPERATE EASTERN AND INTERIOR OR CONTINENTAL LANDS have cold winters and hot summers; the rain (much of which falls in summer), though abundant in the coastal regions, diminishes according to distance from the sea. Areas

experiencing this type of climate are central and eastern Europe, southern Siberia, northern China, Manchukuo, southern Canada and northern United States.

In the wetter parts, except where the trees have been cut down to make room for farming, there are forests of pine, spruce, fir, oak, maple, elm, ash, beech and poplar. Lumbering is an important industry in southern Sweden, Germany, Poland, the U.S.S.R., Manchukuo, and Canada. In the drier parts the natural vegetation is short grass, and these grasslands are known as *steppes* in Europe and Asia, and *prairies* in North America.

Much farming is done both in the places where the forests have been cleared and in the well-watered parts of the grasslands. Maize is grown in the southern warmer districts, and is an especially important crop in the United States, Rumania and Hungary. Farther north wheat is the main crop, and vast quantities are produced in North America, the U.S.S.R., central Europe and Manchukuo. Other products are barley, rye, flax, potatoes and fruits. In addition, much sugar-beet is grown in central and eastern Europe, and millet and soy-beans are cultivated in north China and Manchukuo.

"The Ukraine country we were traversing was covered in luxuriant vegetation. The golden fields of wheat and corn stretched for miles without a single demarcation, lands obviously under cultivation as Collective Farms. These fields were separated from the railway track by belts of rich green maize."

SIDNEY I. LUCK

"From the train window, in speeding from frontier to frontier, you will see a great granary, one of the most fertile in the world. All in all Manchuria embraces some 380,000 square miles. There are forest areas and manufacturing areas, but mostly it is a granary. And to till these fields there is a population of 20 millions of patient and industrious toilers."

LUCIAN SWIFT KIRTLAND

Cattle, horses, sheep, pigs and poultry are kept on most of the farms, and dairy-farming is a noteworthy industry especially in eastern Canada.

THE TEMPERATE ARID LANDS are areas far removed from the sea (as Russian Turkistan, Sinkiang, Mongolia, part of Australia) and certain plateau regions (like central Spain, Iran, Afghanistan, western North America, western Argentina, and western South Africa). In the first case rain-bearing winds drop most of their moisture on the land before reaching these areas, in the second case the winds lose their moisture as they rise to cross the plateaus and so blow over them as dry winds.

In Central Asia there are expanses of barren sand desert, such as the Gobi in Mongolia, the Taklamakan in Sinkiang, the Kara Kum and Kysyl Kum in Russian Turkistan.

“The spot where we were camped was a typical bit of Gobi country, barren and desolate, lifeless save for antelope and lizard, and the ground strewn with coloured pebbles, white, yellow, red, green and blue.”

SIR E. TEICHMAN

In South Africa there is a smaller desert, the Namib :

“The flight over the veld reveals the spreading Sahara of the south—a strange, lost landscape, the veld. The coffin-shaped kopjes, the dry sandy channels where rivers once flowed, the clumps of thorn bush and the eternal smear of khaki before the eyes. At high noon the sun has a tropical fierceness ; at night it is as cold as the steppes of Siberia. A dead landscape, almost devoid of animal life.”

WILLIAM J. MAKIN

In other parts of the temperate arid lands there is sufficient rain for the growth of short grass and shrubs, on which sheep, goats and cattle find pasturage.

“Above all Patagonia (Argentina) is a land of sheep, where great flocks of 15,000 and more are driven along by mounted shepherds.”

MICHAEL H. MASON*

“The fat-tailed sheep is a feature of the Persian landscape ; his tail is triangular, with a little tuft of brownish wool stuck in the centre. They give excellent wool and in large quantities, and during a good grass season, they store up fat in their tails on which they live when food is scarce.”

A. J. REYNOLDS

“I found in Erivan (Armenia) what was the finest specimen I have ever seen of that singular animal known as the ‘fat-tailed

sheep', so often met with in African and Asiatic countries. Whether by gradual changes through domestication or by natural processes this extraordinary appendage has been developed, it is difficult to determine. It consists of two great lobes of fatty matter springing from the body of the animal on each side of the tail, which is so completely embedded in it that it no longer possesses either the appearance or the function of that useful member. So enormously is this peculiar growth developed in some cases that it almost trails upon the ground. It is generally from 25 to 30 pounds in weight, but 40 to 50, and even 60, pounds are not uncommon. It is of an exceedingly delicate nature, more resembling marrow-fat than any other substance, and it is much prized for culinary purposes. It is largely used for soups throughout the country where the animal is bred, producing a most savoury and agreeable article of diet. This variety of sheep, besides being large and yielding an excellent kind of mutton, produces a heavy fleece of wool of fine quality. Possessing so many desirable qualities, I have often wondered why some effort has not been made to introduce it into our own country. It would, no doubt, be possible to do so, as it seems to adapt itself to almost all climatic and physical conditions, for I have met with it from the hot arid plains of Nubia, Ethiopia, Egypt and Central Asia, to the cold, humid atmosphere of the Himalayan and Altai Mountains."

JOHN BOOKWALTER

Wherever water is available, either from rivers or wells, there are fruitful oases. In the warmer regions are grown crops of wheat, barley, tobacco, cotton, sugar-cane, grapes, apricots and peaches, and in the cooler districts wheat, barley, rye, oats, apples and plums.

"The desolation and monotony of the desert begins to give place to what at first glance appear to be vineyards. Closer inspection reveals tufts of white fluff attached to the low vines. We have come to the cotton fields. Just as part of the journey was all steppe, then all desert, now it is all cotton."

ETHEL MANNIN

"Nowhere are fruits more abundant than in Bokhara. The apricots and nectarines I think it would be impossible to surpass

anywhere. Peaches are better in flavour than the best in England. The big Bokharan blue plums are celebrated through the whole of Asia. Besides water-melons, there are in common cultivation ten varieties of early melons, and six varieties which ripen later. Of grapes I noticed thirteen varieties, most of them remarkably good. Large quantities of fruits are dried." E. SCHUYLER

ANIMALS

Wild animals are few in the temperate lands, for these regions are in the main densely peopled and intensely cultivated. In Europe for instance, wolves, though once common, are now met with only among the very secluded forests of the east. The vast herds of wild buffalo and bison that formerly roamed the North American continent are now no more, because farmers have opened up and fenced off the land.

"The only genuine buffalo remaining in Canada are two small lots in captivity—the one near Winnipeg, the other at Banff. Still, one must remember that cattle, horses and sheep have taken the place of the original denizen of the plains."

A. G. BRADLEY

There are smaller animals such as deer, wild boar, rabbit, hare, fox, weasel, badger and squirrel, with lizards and snakes in the warmer parts. Also there are insects and numbers of birds, some of which, like the swallow, migrate to warmer countries at the beginning of winter.

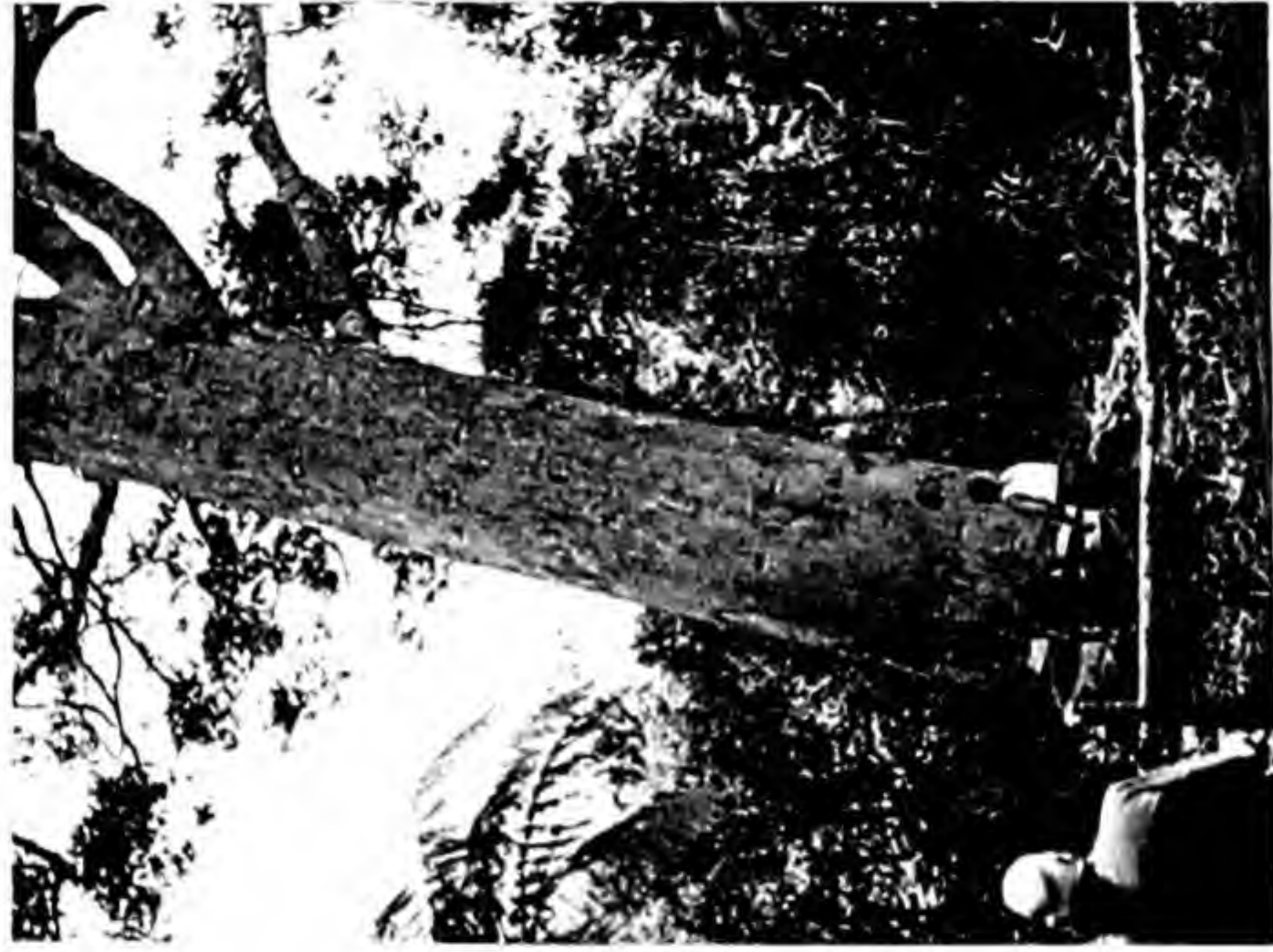
"Summer, winter and spring, it was an unfailing pleasure in Patagonia to listen to the singing of the birds. At a distance from the river, birds were not nearly so abundant, and in the higher uplands a hundred miles from the coast they were very scarce. The common resident mocking-bird was always present, each bird sitting motionless on the topmost spray of his favourite thorn, at intervals emitting a few notes, a phrase, then listening to the others."

W. H. HUDSON (from *Idle Days in Patagonia*)

Bears, mountain sheep and cougars (mountain lions) live in the forests of the Rocky Mountains; rheas (ostriches) and jaguars



Courtesy of the Agent General for New South Wales
KOALA BEARS (page 237)



Courtesy of the High Commissioner for New Zealand
FELLING A KAURI TREE (page 229)

in western Argentina ; bears, wild sheep, wild goats, boars and lions in the mountains of Central Asia.

“ We reached a narrow marshy valley, from which issued a herd of wild boars. The country through which we were travelling abounded in game. In the higher regions were the ibex, the moufflon, and other kinds of wild sheep and goats. Broad-antlered deer were to be found in the wooded valleys. The red-legged partridge, much larger than that of Europe, everywhere abounded.”

SIR HENRY LAYARD

In the temperate regions of Australia there are dingos (wild dogs), kangaroos, and a particular type of small bear, the koala.

“ This little bear is a native of Australia. It is a little larger than a large Persian cat. Its fur is soft, rather short, and completely waterproof, and ranges in colour from shades of silver, fawn, grey to very dark brown, whilst the chest is white. Its diet consists of the leaves of gum trees that are eaten in large quantities.”

CHERRY KEARTON

EXERCISES

1. How are currants and raisins produced?
2. What are : jarrah, cork-oak, maquis, kauri, rhea, cougar, dingo?
3. Why are so many mulberry-trees grown in China and Japan?
4. Explain why animal life is less rich in temperate lands than in tropical latitudes.
5. Rewrite, filling in the missing words :

Lands with a warm temperate climate have — summers and — winters ; if situated on the — margins of the continents they have rain only in winter, if lying on the eastern margins they have abundant rain in — as well as a little rain in —.

In the warm temperate western zone are the countries round the — —, western —, central —, south-west — and south-west — —. These contain woods of —, — —, — and — trees, and

their chief crops are —, —, —, and fruits such as —, —, —, —, — and —. In the warm temperate eastern zone are southern —, southern —, —, southern —, — and — Argentina, — China, —, south-eastern — and — — in New Zealand. These have forests of —, —, —, — and — trees, which merge into grasslands known as — or —. Their chief crops are —, —, —, —, —, —, — and —; and many — and — are reared.

Lands in the cool temperate western vegetation zone (— — Europe, — North America, — Chile, Tasmania and — — in New Zealand) have — winters, — summers, and — — — rain. They have forests of —, —, —, — and — trees, and produce crops of —, —, —, —, and fruits such as — and —. Grass grows — in these regions, providing — — for cattle and sheep. Lands in the cool temperate eastern and interior vegetation zone (— and — Europe, — Siberia, — China, — United States and — Canada) have — summers, — winters, and rain mainly in —. Here there are forests in the wetter parts and grasslands (the — or —) in the drier areas. The chief crops are —, —, —, —, —, — and —. Many —, — and — are reared.

COMPOSITION

The country I would most like to visit.

LOCAL STUDY

Make a list of all the articles used in your home or sold in local shops which come from any of the temperate regions, noting down in which countries they are produced.

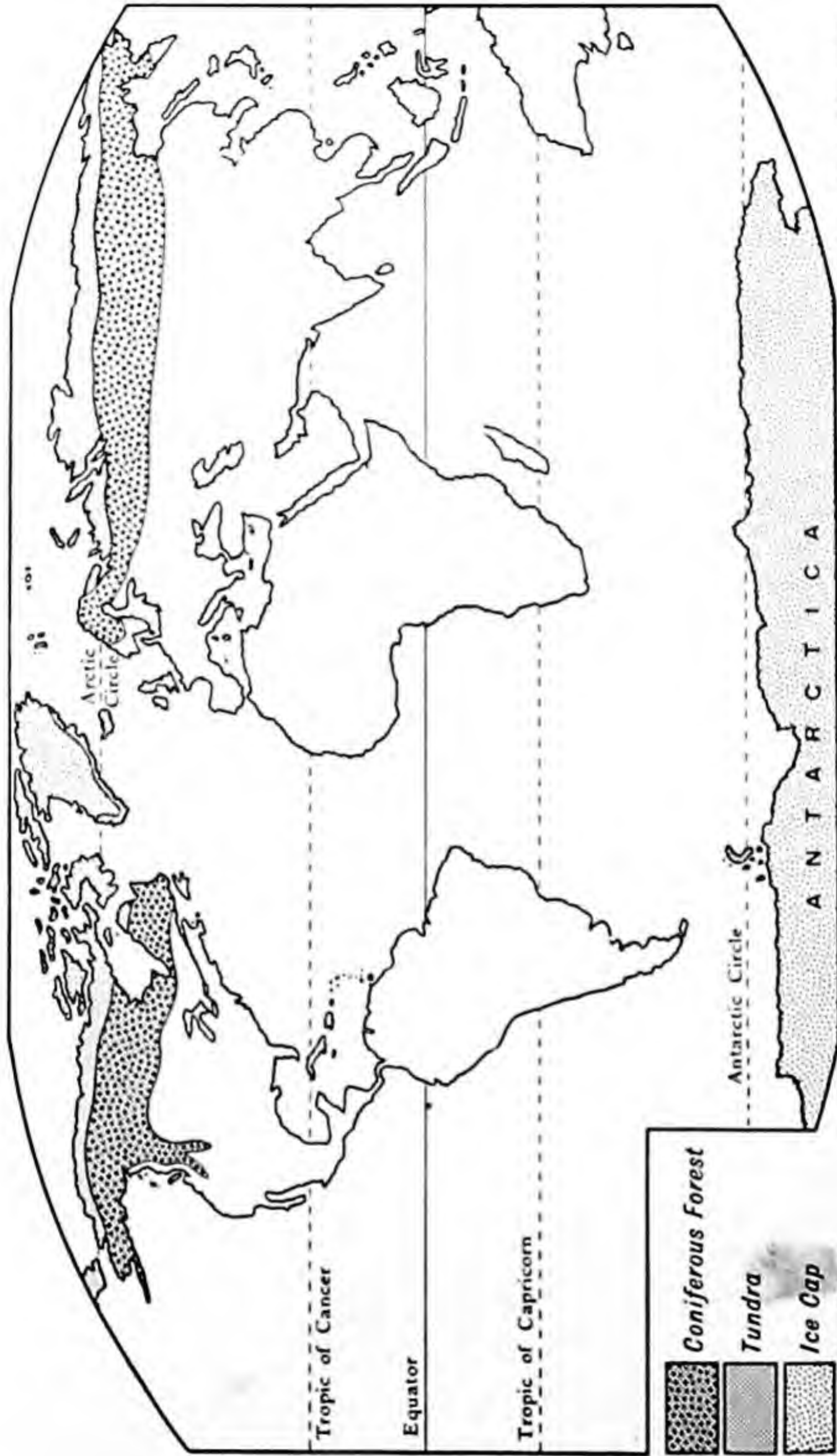
HANDWORK

Draw a series of pictures showing typical scenes, products and animals of the temperate lands.

GAME

A description of the vegetation of any place in the world is given, and the one who guesses correctly the area indicated provides the next description. The descriptions may be criticised by members of the class.

CHAPTER NINE



Emery Walker Ltd. sc.

THE POLAR REGIONS

Denoyer's Semi-Elliptical Projection

CHAPTER NINE

THE POLAR REGIONS

VEGETATION AND ANIMALS

CONIFEROUS FORESTS.—A belt of coniferous forests or taiga extends across Alaska, northern Canada, northern Europe and northern Asia. Winters in this region are long and very severe, summers short and warm. Although there is only a small amount of precipitation, the little that falls as snow melts slowly and is sufficient for the growth of trees. In the northern parts of the belt, owing to intense cold, trees take longer to grow than in the southern parts.

“There is less tree-felling in Lapland, because there the pines take 300 years to reach maturity, whereas in southern Finland trees may reach maturity in 30 years.” **HALLIDAY SUTHERLAND**

The chief trees are spruce, larch, birch, pine and fir. Lumbering is an important occupation in Sweden, Finland and the U.S.S.R.

“All trees are felled in the last months of winter, when the sap is low and the wood is dry. After felling, the branches are lopped off, the log is dragged across the snow to the nearest river, where it is left on the frozen surface. In May the ice melts, and millions of logs begin floating down the rivers, shooting the rapids and collecting in the lakes in their long journey, it may be of hundreds of miles, to the saw-mills and paper factories for the most part on the seaboard.” **HALLIDAY SUTHERLAND**

Many fur-bearing animals live in the forests : sable, ermine, mink, marten, otter, musquash, beaver, fox, squirrel, bear, wolf and wolverine. These are hunted by trappers during the winter when their furs are at their best. In the taiga also live larger animals : caribou, reindeer, elk and moose.

"The moose, the largest living member of the deer family, ranges over the whole forest country of Canada and Alaska. A big Alaskan bull-moose will stand well over seven feet at the shoulder, while his huge palmated antlers commonly have a span of six feet. Wolves are common in all parts of the North except in the neighbourhood of the lower Mackenzie River, where big game is scarce. All over the mountainous districts they follow the caribou herds, pulling down the stragglers. A timber wolf is undoubtedly the most formidable animal, but I am absolutely convinced that under no conditions, save those of absolute famine and self-defence, will wolves attack a human being. While hunting alone I have been followed by wolves, day after day; I believe it was partly curiosity and partly the hope of sharing the kill. I was sleeping in open camps night after night and allowed the fire to die down while I slept, but the wolves never approached nearer than fifty yards." MICHAEL H. MASON

The rivers and lakes abound with fish: whitefish, trout, pike, salmon and sturgeon. In summer there are many birds, especially ducks, geese, herons and terns, and there are also countless mosquitoes.

This region, except for Sweden and Finland, is very scantily peopled, and so little farming is attempted. But where the forests have been cleared, oats, barley, rye, potatoes and turnips are grown, and cattle reared.

TUNDRA OR ARCTIC PRAIRIES.—The northern coastlands of Siberia, Alaska, Canada and the coasts of Greenland are known as the arctic prairies or tundra. Average temperatures here are never above 50° F. even during the summer, and temperatures of many degrees below zero are common during the long winter.

"It was only the second week in September, but snow that fell incessantly did not melt again, and every lake was solidly bound with ice."

DIAMOND JENNESS

Temperatures in this region are too low and precipitation too scanty for the growth of trees, but during the short cool summer grasses and flowers, mosses and lichens flourish.



Courtesy of the Swedish Travel Bureau

CONIFEROUS TREES, SWEDEN (page 241)



Courtesy of the Canadian National Railways

WINTER MAIL ABOUT TO LEAVE CHURCHILL, CANADA (page 246)

“ It is a surprise to many people to learn that, wherever there are soil and firm earth, flowers will grow. In the northernmost corner of Greenland I have seen yellow poppies and exotic red flowers. These prepare for the short summer season by developing into buds the previous autumn. Then they hibernate under the protection of their own foliage and, at the first hint of sunshine and warmth, burst into full bloom.”

PETER FREUCHEN

“ During the summer, Alaska, even as far north as the Arctic Ocean, is carpeted with the most daintily coloured and beautiful wild flowers.”

J. J. UNDERWOOD

The sea is rich in various kinds of fish, and also contains seals, walrus and whales. In summer there are many birds such as auks, ducks, geese, gulls and terns. The chief animals of the tundra are the arctic hare, arctic fox, reindeer and polar bear.

“ Shugliak¹ is the home of the arctic fox. These foxes the Eskimos trap all winter, bringing the snowy pelts in for trade from time to time.”

GEORGE M. SUTTON

“ It seems hardly right to call polar bears *land* animals ; they abound here—110 geographical miles from the nearest land—upon very loose broken-up ice, which is steadily drifting into the Atlantic at the rate of 12 to 14 miles daily ; to remain upon it would secure their destruction were they not nearly amphibious ; they hunt by scent, and are constantly running across and against the wind, which prevails from the northward, so that the same instinct which directs their search for prey, also serves the important purpose of guiding them in the direction of the land and more solid ice. No instance is known of Greenland bears attacking men, except when wounded or provoked. A native of Upernivik, one dark winter's day, was out visiting his seal-nets. He found a seal entangled, and, whilst kneeling down over it upon the ice to get it clear, he received a slap on the back—from his companion as he supposed ; but a second and heavier blow made him look smartly round. He was horror-stricken to see a peculiarly grim old bear instead of his comrade! Without deigning further

¹ Shugliak is the local name for Southampton Island, Canada.

notice of the man, Bruin tore the seal out of the net and commenced his supper. He was not interrupted ; nor did the man wait to see the meal finished.”

F. L. M'LINTOCK

The mosquitoes during the summer are as numerous as those in the tropics.

“ The days grew warmer and more pleasant as spring gave place to summer. Yet its coming was not an unmixed blessing, for it hatched out myriads of mosquitoes that rose and fell in the atmosphere like the motes in a sunbeam. How so many could exist was a mystery. Wherever we travelled they hovered around us like bees swarming, and no smudge could keep them at bay. My tent became the common refuge, for its doorway of fine netting resisted all their assaults, though they pattered on the roof like rain. Outside everyone wore mittens as in winter. Only on the ice could we escape the insects, their flight being limited to about a quarter of a mile, unless the wind carried them farther.”

DIAMOND JENNESS

The only inhabitants of these regions are tribes of Eskimos and Lapps who live by hunting and fishing, and keep reindeer herds.

“ The natives spend their days fishing in summer and hunting in winter. At the beginning of October they start on snow-shoes. Alone, or in company, the hunter goes into the forest.”

HENRY LANSDELL

“ From the hides of the reindeer the Eskimos make their own muluks for footwear, their own thread from deer sinews. They use the tails for shaving brushes, the hoofs for glue, the marrow on bread to serve as butter. From the antlers they make their knives. In addition they are assured of fresh meat the year round.”

MAX MILLER

Many of the people still live in snow houses in winter and tents in summer.

“ Among the Central Eskimos, and to some extent in Labrador, the snow house is the sole winter dwelling.”

K. BIRKETT SMITH

“ When summer came, the Lapps started putting up their tents. First the simple yet perfect combination of tent poles which no wind could separate. Then came the covering of vad-

mal, a peculiar texture of great coarseness which breaks the wind, yet allows it to pass through the tent softly. To resist the wind entirely might result in the sweeping away of the whole tent. On the cross-poles pots were swung. Snow was heaped in the pots and the frozen meat made ready for boiling." A. R. EVANS

For fishing the inhabitants use small boats called kayaks.

"The kayak is made of sealskin. It is completely covered over except for a round aperture in the middle for the man's body. The man sits at the very bottom of the kayak, dressed in a seal-gut parkie. The hood of this garment is tied tightly round his face, and the bottom is tied round a rim on the boat, making the combination of man and kayak absolutely waterproof."

MICHAEL H. MASON

People travel in winter by means of snow-shoes or skis or on sledges drawn by dogs or reindeer, and in summer by canoeing on the numerous rivers and lakes.

THE ICY BARRENS.—The areas immediately surrounding the poles are icy wastes where temperatures are always so low that the snow and ice never melt and nothing can grow. At the North Pole there are only scattered islands, among them the large island of Greenland, the entire interior of which consists of icy barrens. At the South Pole there is the continent of Antarctica, a great expanse of desolate waste.¹

"There is not a flower to be seen, for, beyond a few tiny plants, there is no vegetation in the Antarctic, no green leaves, indeed no hint of bright colour of any sort; only black and white and spectral grey: a land of death."

A. G. BENNETT

The cold is so severe in these regions that they are uninhabited by human beings, and the only animal life consists of sea creatures, whales and fish, and birds that obtain their food from the sea.

"As far as its land surfaces are concerned, the Antarctic may be summed up as a vast wilderness of ice, on which no land animals can exist. Even the ubiquitous rat and mouse are absent. There are no larger insects than a minute fly. The land,

¹ Antarctica is surrounded by sea, and therefore there is no taiga and tundra in the Southern Hemisphere.



REINDEER (page 245)

Courtesy of the Swedish Travel Bureau



PENGUINS (page 248)

A Kodak Snapshot

in fact, produces such an infinitesimal amount of vegetation that it cannot support animal life. None the less there is plenty of life here, but all its food is obtained directly or indirectly from the sea."

A. G. BENNETT

The following is a description of typical conditions experienced near the shores of Antarctica :

"At dusk we made fast to a heavy floe, but our hopes of a quiet night were quickly shattered, for we were soon compelled to cast off because pieces of loose ice began to work round the floe. Constant rain and snow squalls blotted out the stars and soaked us through, and at times it was only by shouting to each other that we could keep the boats together. Nobody, owing to the severe cold, had any sleep, and since we could only see a few yards ahead we did not dare to pull fast enough to keep ourselves warm. All around us we could hear the killer-whales blowing, their short, sharp hisses sounding like sudden escapes of steam. They were a source of great anxiety, for a boat could easily have been capsized by one of them coming up to blow ; and we had an uneasy feeling that the white bottoms of the boats would look like ice from below."

SIR ERNEST SHACKLETON

The most interesting birds in Antarctica are the penguins :

"The penguins always excite fresh interest in everyone who sees them for the first time. Their resemblance to human beings is always noticed. This is partly due to the habit of walking erect, but there are truly a great many human traits about them. They are curious about any unusual object and will come a long way to see a man. When out on these excursions the leader of a party keeps them together by a long shrill squawk. Distant parties salute in this way and continue calling till they get pretty close. A party can be made to approach by imitating the call. Emperor penguins are very ceremonious in meeting other emperors or men or dogs. They come up to a party of strangers in a straggling procession, some big important aldermanic fellow leading. At a respectful distance from the man or dog they halt, the old male waddles close up and bows gravely till his beak is almost touching his breast. Keeping his head bowed he makes

a long speech, in a muttering manner, short sounds following in groups of four or five. Having finished the speech, the head is kept bowed a few seconds for politeness' sake, then it is raised and he describes with his bill as large a circle as the joints of his neck will allow, looking in your face at last to see if you have understood. If you have not comprehended, as is usually the case, he tries again. By this time his followers are getting impatient. They are sure he is making a mess of it. Another male will waddle forward with dignity, elbow the first aside as if to say, 'I will show you how it ought to be done', and goes through the whole business again. Their most solemn ceremonies were used towards the dogs, and three old fellows have been seen calmly bowing and speaking simultaneously to a dog, which for its part was yelping and straining at its chain in the effort to get at them. Left to themselves the emperor penguins seem perfectly peaceable, and no sign of quarrelling was ever noticed. They seem to regard men as penguins like themselves. They are quite unsuspicious and slow to take alarm, so long as you stay still or move very slowly. If you walk too fast among them, or if you touch them, they get frightened and run away, only fighting when closely pressed. As one slowly retreats, fighting, he has a ludicrous resemblance to a small boy being bullied by a big one, his flipper towards the foe elevated in defence, and making quick blows at the bully. It is well to keep clear of that flipper when he strikes, for it is very powerful, and might break an arm."

JAMES MURRAY

MOUNTAINS

High mountains make their own climate and vegetation regions, as the temperature drops about 1° F. for every 300 feet ascended. This rule is not affected by latitude, for even in the tropics, although the bases of lofty mountains are covered with equatorial forests, their summits are permanently snow-capped, and the intervening slopes show every type of vegetation: tropical grassland, temperate forest, temperate grassland, and coniferous forest.



Courtesy of the Swiss Federal Railways. (Photo M. Rudolf)

MOUNTAIN VEGETATION IN EUROPE

Farmlands, forests and grasslands on the Swiss Alps.

Examples are the Himalaya of India, the Andes of South America, the Rockies of North America, and the great mountains of the East African Plateau.

“Reviewing the sequence of vegetation, from the lowest valleys to the alpine tops, we find an epitome of what takes place in the course of a journey from the equator to the north pole. The valleys are filled with sub-tropical jungle. The next higher zone, where snow falls in winter, is the temperate rain forest ; here there is great variety, though not so great as in the jungle ; climbing plants are rare. 2,000 feet higher up the winters lengthen out and the conditions are altogether more severe. The forest is composed almost exclusively of fir and spruce, with scattered larch. This we may compare with the coniferous forests of northern Europe, Siberia and Canada. At last forest ceases altogether, and we step from darkness into light ; we have reached the alpine region.”

F. KINGDON WARD*

Tropical lands containing plateaus and mountains thus have a series of different vegetation regions within their borders. Mexico, the countries of Central America, western South America and East Africa all possess hot lowlands, warm temperate plateaus and cool highlands. Ethiopia in East Africa is noted for the diversity of its climate and vegetation.

“For agricultural purposes Ethiopia is divided into three definite zones according to altitude. In the lower plateau between sea-level and about 3,000 feet, the temperature is high and the rainfall low, while the country consists of steppes, marshes and jungle ; the vegetation is tropical. In the regions between the high mountains and the low plateau from 3,000 to 7,500 feet, the temperature is moderate and the rainfall high ; the country consists of fertile valleys, rolling plains and hills, interspersed with forest and jungle ; fig trees, cactus and coffee grow wild, while many varieties of European fruits, flowers and vegetables increase rapidly once they are introduced. The mountainous regions over 7,500 feet have low temperatures and frequent night frosts ; prairie grass and woods are characteristic of the vegetation.”

E. W. POLSON NEWMAN

EXERCISES

1. Explain what are the following : taiga, tundra, kayak, moose, caribou, snowhut, floe.
2. Give a short account of the lumbering industry in the coniferous forest region.
3. Why do the fur trappers work during the winter?
4. Describe briefly the vegetation that clothes the slopes of a lofty mountain situated in the tropics, and of one in Europe.
5. Rewrite, filling in the missing words :

The polar lands consist of — belts : the —, the — and the —. In the taiga or — — region there is sufficient — and — for the growth of trees, and many — — animals live in the forests. The tundra or — — are — — wastes during the long severe winter, but during the short summer —, — and — grow. The barrens surrounding the poles have such uniformly — temperatures that they have no —.

COMPOSITION

The story of the Antarctic explorer and the penguins.

LOCAL STUDY

Prepare either of the following :

(a) A list (with sketches) of the different kinds of wood used for articles in your home and school or on sale in local shops, noting their colours, textures, etc.

(b) A list (with sketches) of the different varieties of furs sold in nearby shops, mentioning from where they have been obtained.

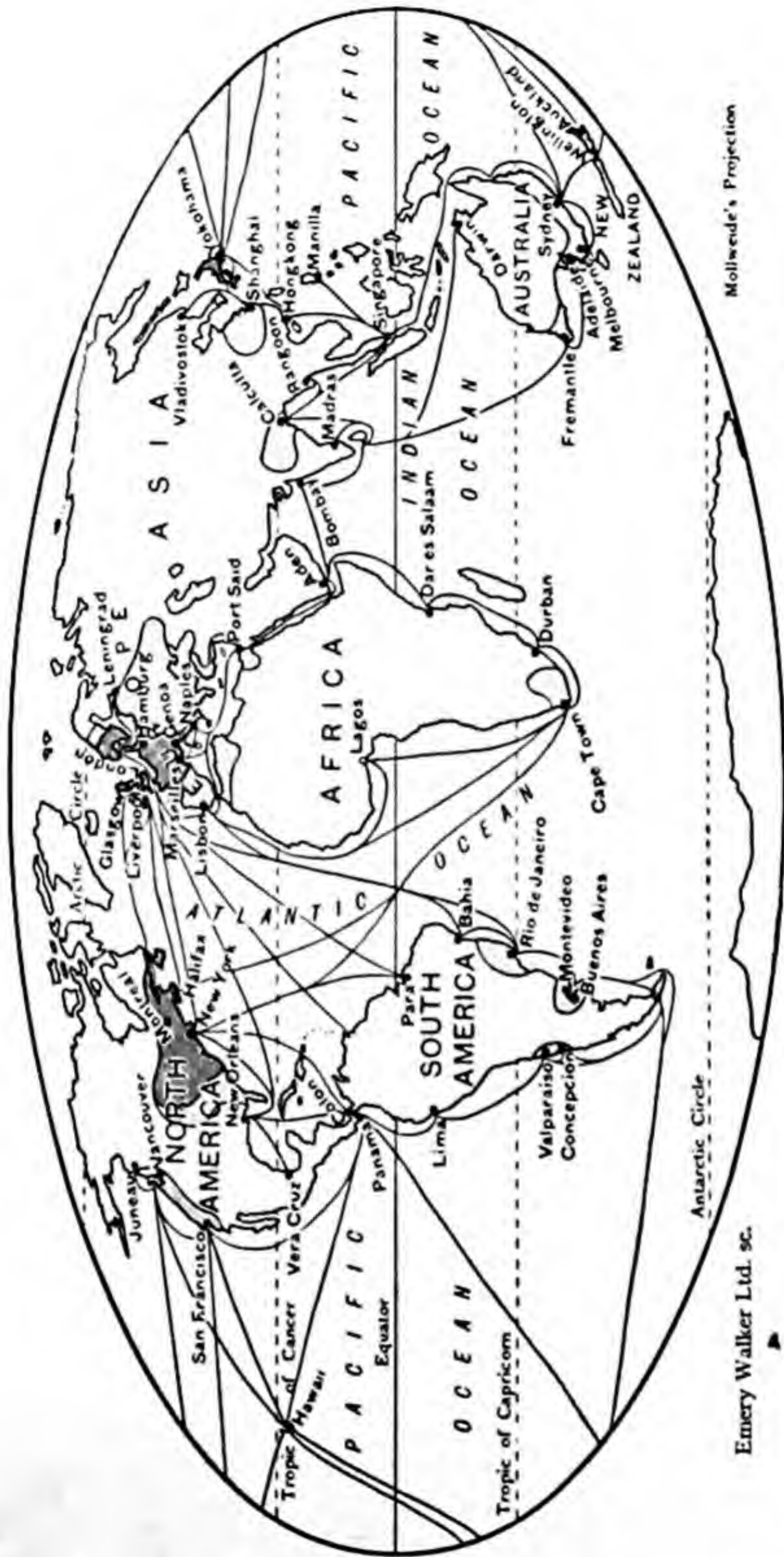
HANDWORK

Draw a series of pictures to illustrate life in the polar regions.

GAME

From the pictures drawn for Handwork in this and the previous two chapters, one is selected and shown to the class. The first to state which part of the world it might be found in or represents chooses the next picture.

CHAPTER TEN



Mollweide's Projection

Emery Walker Ltd. SC.

THE WORLD'S CHIEF MANUFACTURING REGIONS AND OCEAN ROUTES

CHAPTER TEN

TRADE AND TRANSPORT

MANUFACTURING.—People are obliged to do a certain amount of manufacturing wherever and however they may live. Food has to be prepared, clothes fashioned, shelters built, and tools have to be made to carry out these processes. These needs are universal, and the desire to satisfy them has led to the establishment of a measure of manufacturing in every country. But although established everywhere, manufacturing has not been developed in some areas as much as in others.

In polar regions the severe climate and lack of natural products force the inhabitants to wage a perpetual struggle for existence; they have no time or energy left to consider anything other than bare necessities. In tropical lands crops grow readily all the year round, there is an abundance of fruit and nuts, much food can be eaten uncooked, few clothes are required, homes can be of the simplest; thus there is no great incentive to develop manufacturing.

“Java is the epitome of the tropical island. Marvellously fertile, the cultivated fields amazingly rich—growing, and growing in sun-drenched violence. The island is one of the most densely populated areas in the world.” SIR EDGAR BRITTEN

In the middle latitudes life is neither as difficult as in the polar regions, nor as easy as in the tropics. Crops grow well in the summer season, but in winter the people need food saved from the summer, warm clothes, and strongly-built and artificially-warmed houses. The need to supply these requirements is a stimulus to industry. In addition, steady work is most easily done in lands where the weather is neither too hot nor too cold to cause discomfort to the workers. Thus we find that the ten great industrial centres of to-day are almost all situated in tem-

perate lands. They are, in the order of their importance : Europe, north-eastern United States and south-eastern Canada, the western coastlands of the United States and Canada, Japan and north China, the Buenos Aires and Montevideo district, south-eastern Australia and northern New Zealand, the area around Rio de Janeiro, the Cape Town district, north-eastern India. These places produce the bulk of the world's manufactured goods and distribute them among other nations.

Europe was the first region to develop manufacturing on a large scale. In the beginning the people concentrated on providing comforts for themselves, and then, as they learnt of the products of more favoured lands, such as spices, cotton, tobacco, fruits, cocoa, coffee, tea, they began to produce an excess of goods so as to have something to exchange for the articles they lacked and desired. Gradually many of the Europeans gave up agricultural pursuits and left the country to congregate in towns devoted to manufacturing. Later as the populations increased, groups of them emigrated and set up industries in the newer countries in North America, South America, Australia and South Africa ; while Japan and northern India introduced manufacturing to provide gainful employment for their dense populations.

Originally all goods were made by hand. To-day in the leading manufacturing areas almost everything is done by machinery. Centuries of inventions and improvements have resulted in the intricate machines used in present-day factories. These make goods very quickly and cheaply and one machine can do the work of ten or more persons.

" In the vast weaving shed, ran row after row of these greedy, noisy looms, absorbing miles upon miles of the delicate yarn and transforming it into innumerable rolls of cotton cloth, apparently without any human intervention. For so amazingly efficient are these looms that one young girl can control between 30 and 40 of them."

ERNEST PICKERING

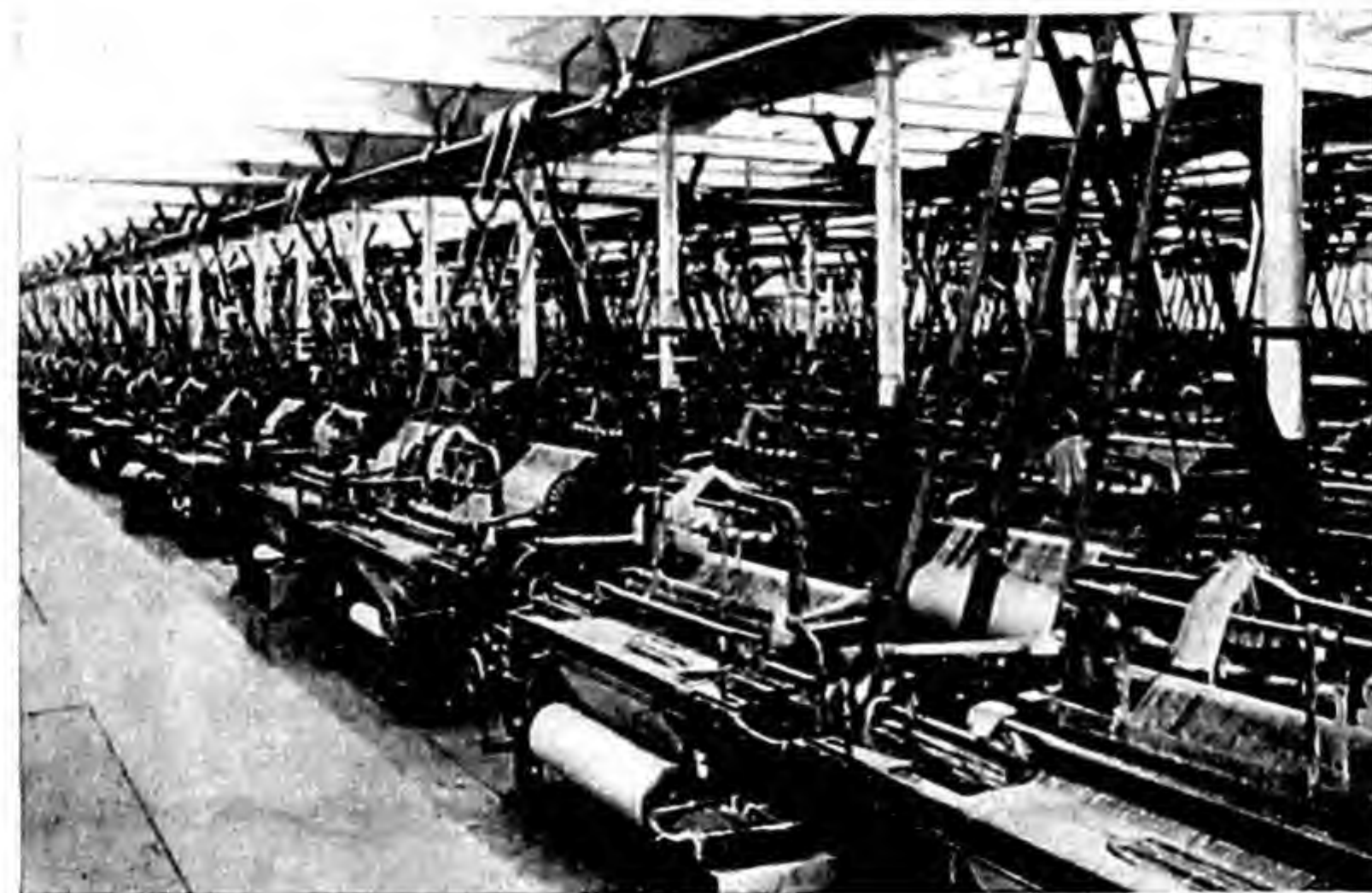
Since machines produce goods so easily in great quantities, the factories have steadily increased their output, and at the same time needed more and more raw materials to use. People in the



COPPER CRAFTSMEN OF EGYPT

Courtesy of the Egypt Travel Bureau

MAKING GOODS BY HAND (page 258)



WEAVING JUTE, CALCUTTA

Courtesy of the Imperial Institute

MAKING GOODS IN A FACTORY (page 256)

less industrialised areas have thus found a ready sale for their raw products and accepted in return manufactured goods. This basis for co-operation has helped to encourage industries in temperate lands and retarded the development of manufacturing in tropical countries. Whether such a state of affairs will continue is doubtful, for many places which formerly bought ready-made articles are now setting up their own factories.

Manufacturing can be either simple or complex. Simple manufacturing consists of such processes as milling wheat, canning fruits and vegetables, curing and preserving meat and fish, extracting sugar from sugar-cane, making wood-pulp from timber, and smelting mineral ores. Such manufacturing calls only for one particular raw product and is largely done in the neighbourhood where the raw material is obtained. Complex manufacturing is necessary to produce articles like motor-cars, locomotives, ships, aeroplanes, chocolate and confectionery, fashionable clothing, gramophones, typewriters, books. In these cases each product needs many raw materials and prepared materials for its construction, and this type of industry is less general, being carried on mainly in Europe, eastern North America and Japan.

Despite the immense output in machine-made goods, hand-made articles are still produced to some extent. In isolated places this is still the common rule. The pygmies of the Congo forest make their own bows and arrows, the nomads of Mongolia weave their own cloth, and housewives on lonely farms bake their own bread. Certain hand-made goods are superior in quality and appearance to those made by machines, though they take much longer to make and are therefore more expensive. Even so there is a market for such articles as Persian, Turkish, Indian and Afghan carpets, Maltese lace, Rumanian embroidery, Irish hand-woven linen, Harris tweed, Ecuadorian and Peruvian Panama hats, Chinese inlaid work, Egyptian and Indian metal work, etc.

TRADE.—Manufacturing naturally leads to trading. Manufacturers wish to sell their goods and buy further materials for making more goods, and to obtain a profit while doing so. Up

to certain limits the more goods that can be bought and sold the better for man's comfort and pleasure. In order to stimulate sales manufacturers advertise their goods through the press, the radio, and indirectly through the cinema.

In early times all trading consisted in the exchange of one class of goods for another. Later money was used and buying and selling made simpler. As trade expanded, banking and payment by cheque were introduced to avoid the exchange of bulky quantities of money. In international trade actual money is not involved, for the goods are sold and bought by means of bills of exchange; the banks pay out or collect the amounts stated on the bills to the individual traders, and balance their own accounts by collecting the various bills of exchange which enter each country.

TRANSPORT.—Trade depends on transport. Raw materials have to be brought to factories, manufactured goods sent to markets, and the more industrialised a country is the more complex is its transport system. Nowadays articles of all kinds are carried over land and sea to the farthest corners of the world. Parisian gowns can be bought in Buenos Aires, Californian raisins in London, Indian carpets in New York, a ship built in Great Britain sails across Lake Titicaca on the Andean Plateau of South America.

“To-day Singapore gets fresh meat from Australia, fresh butter from New Zealand, swede turnips from Sumatra, potatoes from Palestine, tomatoes from Java, rhubarb from New South Wales, oranges from China, and cabbages, lettuces and salads from the Malayan hill-station of Cameron Highlands.”

R. H. BRUCE LOCKHART

Goods are transported over land by aeroplanes, motor-lorries, railway trains, animals and men.

Transport by aeroplane is the most rapid method, but it is also the most costly. It is therefore used only for the carriage of small goods that sell at high prices: gold, out-of-season fruits and flowers, etc.



A MOUNTAIN ROAD (page 261)

Courtesy of the Italian State Tourist Department

“It was something for us to marvel at that the giant planes that left the airport in Los Angeles three times a day and roared away above our heads, reached New York less than seventeen hours later. By the ordinary train time the journey consumes four full days. By road, it took us twelve days.” G. K. AUSTIN

Motor transport is also fairly expensive, but as it takes goods from door to door, it eliminates carriage to and from a railway station and the consequent loading and unloading. Since motor-cars can be used wherever there are suitable roads, many countries have introduced automobile services in preference to constructing additional railways. Motor-lorries and buses run regularly between most of the world's towns and connect them with outlying villages. There are also services over high mountains, as well as across deserts such as those from Jerusalem to Bagdad and from Algiers to Timbuktu; and there is one in Finland from the capital to the shores of the Arctic Ocean.

Railways transport goods over land at a reasonable cost and speed. The development of world trade received indeed an impetus from the nineteenth century invention of the steam engine. To-day almost every country has railways running between its chief cities and villages, and linking them with the cities of neighbouring lands. Famous trans-continental lines are the Trans-Siberian across Europe and Asia, the Canadian Pacific and Canadian National across North America, and the Trans-Andine across South America. The great capitals of the world are the central points of intricate networks of railways, and some, such as London, Paris, Berlin, Moscow, Tokyo, New York and Buenos Aires, have in addition miles of underground railways running beneath their busy streets.

In the industrialised areas animals are used only for hauling goods short distances, mainly to and from railway stations and docks. But in some places, particularly the more isolated parts of the world, they are the chief means of transport. Horses are used in temperate latitudes, donkeys and mules in hilly districts, oxen and elephants in hot countries, dogs and reindeer in polar regions, camels in deserts.

"Without camels it is difficult to see how the inhabitants of the interior Sahara could subsist, for they are, in essentials, the only animals truly adapted to long journeys in barren land, where water and food are often very scarce. The distance they can travel with 300 to 400 lbs. loaded on their backs, and their uncomplaining endurance is altogether marvellous, and it would be a man of poor appreciation indeed who knew their habits and had no praise for them."

ANGUS BUCHANAN

Everywhere men load and unload goods, but in certain districts, especially difficult mountainous or forested country, they are employed as baggage carriers.

Transport by water is much cheaper than by land. There are no costly roads or tracks to be constructed and afterwards kept in good repair, no bridges or tunnels to be built. Most traders therefore prefer to send their goods by boat whenever possible, even if it means a journey longer by several hundred miles; in fact the world's industrial centres are all situated within easy reach of the sea or near rivers and lakes.

The oceans and seas of the world are crossed and recrossed in all directions by ships of every kind and size, carrying every conceivable type of produce. And to make sea journeys easier canals have been built, the most important of these being the Suez Canal connecting the Mediterranean with the Red Sea, and the Panama Canal between the Atlantic and Pacific Oceans.

The world's great rivers are as busy as the seas, and many of them have also miles of inter-connecting canals. The St. Lawrence of North America, the Rhine and Danube of Europe, the Volga of the U.S.S.R., the Ganges of India, and the Yangtse-kiang of China, are among those that carry tremendous amounts of shipping. Here is a description of traffic on the Volga in summer and winter:

"Up and down this mighty waterway in summer there is an unceasing movement of innumerable boats, ships, rafts, lighters, and steamers, with thousands of people, and with precious cargoes of the crops and products of the rich land. In November ice begins to form; but as soon as the ice is thick enough, it makes

for three or four months a splendid highway for a lively sledge traffic up and down the river or across it. The railways, too, make use of it ; rails are laid from bank to bank at places where there are no bridges, and so the goods-wagons are taken over without the costly use of ice-breakers.”

FRIDTJOF NANSEN

“ Thai is a land almost without highways. Except for the few railway lines all travel is by water, as there is a network of rivers and streams.”

L. S. KIRTLAND

COMMUNICATIONS.—Trading led to a need for rapid and easy communications. All countries have efficient and regular postal services, and letters are carried from one land to another by express trains, mail boats and aeroplanes. The chief towns of the world are linked by telegraph and telephone systems, messages are sent across the oceans either by underground cables or by wireless waves, and practically all countries have radio stations from which they send out and receive the latest news.

POLITICAL DIVISIONS.—The world is divided up into many countries,¹ each with its own government, laws and customs, many with their own languages. Some countries are connected with one another by ties of race and history. A few European nations have colonised other lands and built up empires.

“ There is nothing in history comparable to the way this relatively small European part of the human race, moving out from a comparatively still smaller area, has thrown not simply its political influence but the whole net of its civilisation and techniques over the rest of mankind.”

GROVER CLARK

Nations when at war have seized each other's lands and added them to their own kingdoms. The history of the world's division into nations is a tale of strife and rivalry, but perhaps there will come a time when men of all races will live harmoniously together, and as the poet Alfred Tennyson hoped, the world will be ruled by a parliament representing all mankind. The maps and charts

¹ These are dealt with individually in the other volumes of *The Complete Geography Series*.

on pp. 269-274 describe the present political divisions of the world (Spring, 1940).

EXERCISES

1. Why are the world's most industrialised regions situated in the middle latitudes and within easy reach of the sea?

2. Make a list of the chief means of land transport, mentioning the reasons which lead to the use of each.

3. Explain what is meant by : raw materials, complex manufacturing, cheques, trans-continental railways, canals, political divisions.

4. Give reasons for the development of the following industries : wheat-milling in Canada, fruit- and vegetable-canning in California, sugar-refining in Cuba, meat-packing in Argentina, wine-making in France, paper- and pulp-making in Sweden, fish-canning in Japan, ore-smelting in Australia, butter-making in New Zealand.

5. Rewrite, filling in the missing words :

Some manufacturing has to be done everywhere, for all people need —, —, — and —, but in certain regions manufacturing is so highly developed that great quantities of goods are made and sold to the other countries of the world. Foremost among these industrialised regions are — and — — — —. Manufacturers require good — — in order to obtain raw materials for their factories and despatch their finished goods to the —. They also need good means of communications so that they can —, —, — and — to their customers.

COMPOSITION

The blessings brought by machines.

A description of an article I made myself.

LOCAL STUDY

Select one of your nearest manufacturing establishments (factory, builder, shoemaker, baker, dressmaker, etc.), and write an

account of the work carried on there, the people employed, the raw materials used, from where they are obtained, etc.

HANDWORK

On a map of the world mark in the areas where the world's chief products (i.e., wheat, beef, wool, cotton, tea, etc.) are produced in large quantities.

GAME

Someone mentions any manufactured article. The one who first gives a list of the raw products needed in its manufacture with their probable place of origin suggests the next article.

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THE POLITICAL DIVISIONS OF THE WORLD

IN ORDER OF SIZE

MORE THAN 1,000,000 SQUARE MILES IN AREA

	<i>square miles</i>
British Commonwealth *	13,355,426
U.S.S.R. - - - -	8,175,728
France * - - - -	4,835,843
United States * - - - -	4,396,367
Brazil - - - -	3,275,510
China - - - -	2,000,000 (approx.)
Japan * - - - -	2,000,000 (approx.)
Italy * - - - -	1,398,118
Argentina - - - -	1,079,965
Mongolia - - - -	1,000,000

MORE THAN 500,000 SQUARE MILES IN AREA

Belgium,* Portugal,* the Netherlands,* Denmark,* Mexico,
Iran, Sinkiang, Saudi Arabia, Bolivia.

MORE THAN 100,000 SQUARE MILES IN AREA

Peru, Tibet, Colombia, Egypt, Venezuela, Spain,* Germany,
Chile, Turkey, Ecuador, Afghanistan, Thai, Sweden, Norway,
Finland, Iraq, Rumania.

MORE THAN 10,000 SQUARE MILES IN AREA

Jugoslavia, Oman, Yemen, Uruguay, Paraguay, Nicaragua,
Nepal, Greece, Guatemala, Honduras, Cuba, Liberia, Bulgaria,
Hungary, Panama, Costa Rica, Lithuania, Latvia, Dominica,
Estonia, Bhutan, Switzerland, Salvador, Haiti.

* With overseas possessions or dominions.

The chief countries mentioned here are shown on the map opposite ; the countries are arranged according to their position on the map.

THE BRITISH COMMONWEALTH

In Europe : Great Britain and Northern Ireland, Eire, Gibraltar, Malta.

In Africa : Union of South Africa, Basutoland, Swaziland, South West Africa, Bechuanaland, Southern Rhodesia, Northern Rhodesia, Nyasaland, Tanganyika, Zanzibar, Kenya, Uganda, British Somaliland, Anglo-Egyptian Sudan, British Cameroons, Nigeria, British Togoland, Gold Coast, Ashanti, Sierra Leone, Gambia ; islands of Seychelles, Mauritius, St. Helena, Ascension, Tristan da Cunha.

In Asia and Australasia : Cyprus, Palestine, Transjordan, Aden and Dependencies, British India, Ceylon, Burma, Hong Kong, Malaya, Federated Malay States, Unfederated Malay States, Sarawak, Brunei, North Borneo, New Guinea, Papua ; Australia, Tasmania, New Zealand, Pacific Islands (Bismarck, Solomon, New Hebrides, Fiji, Tonga, Western Samoa, Phoenix, Gilbert, Ellice, Pitcairn, etc.).

In the Americas : Canada, Labrador, Newfoundland, the Bermudas, British West Indies (Bahamas, Jamaica, Leeward and Windward Islands, Barbados, Trinidad), British Guiana, British Honduras, Falkland Isles.

FRANCE

In Europe : France, Corsica.

In Africa : Tunis, Algeria, Morocco, Mauritania, Senegal, French Sudan, French Guinea, Ivory Coast, French Togoland, Dahomey, Niger, French Equatorial Africa (including French Cameroons), French Somaliland, Madagascar and Dependencies, Réunion.

In Asia : Syria, Lebanon, French India, Indo-China, Pacific Islands (New Caledonia, New Hebrides, Society, Tuamotu, Marquesas).

In the Americas : French Guiana, the islands of Guadeloupe, Martinique, St. Pierre, Miquelon.

UNITED STATES

In the Americas : United States, Alaska, Puerto Rico, Virgin Islands.

Pacific Islands : Philippines, Guam, Eastern Samoa, Hawaii.

THE NETHERLANDS

In Europe : The Netherlands (Holland).

In Asia : Netherlands Indies (Sumatra, Banka, Billiton, Java, Madura, Bali and Lombok, Timor Archipelago, Western New Guinea, Moluccas, Celebes, Dutch Borneo).

In the Americas : Dutch Guiana, Curaçao.

DENMARK

In Europe and North Atlantic : Denmark, Faroe Islands, Iceland, Greenland.

Chief countries mentioned here are shown on the map opposite.

ITALY

In Europe : Italy, Sardinia, Sicily, Albania, Dodecanese Islands.

In Africa : Libya, Italian East Africa (Ethiopia, Eritrea, Italian Somaliland).

BELGIUM

In Europe : Belgium.

In Africa : Belgian Congo.

SPAIN

In Europe : Spain, Balearic Islands.

In Africa : Spanish Morocco, Ifni, Canaries, Rio de Oro, Spanish Guinea, Islands of Fernando Po, Annobon, etc.

PORTUGAL

In Europe : Portugal.

In Africa : Angola, Mozambique, Portuguese Guinea, Principe, Sao Thome, Cape Verde Is., Madeira.

In Asia : Portuguese India, Eastern Timor.

U.S.S.R.

(Union of Soviet Socialist Republics)

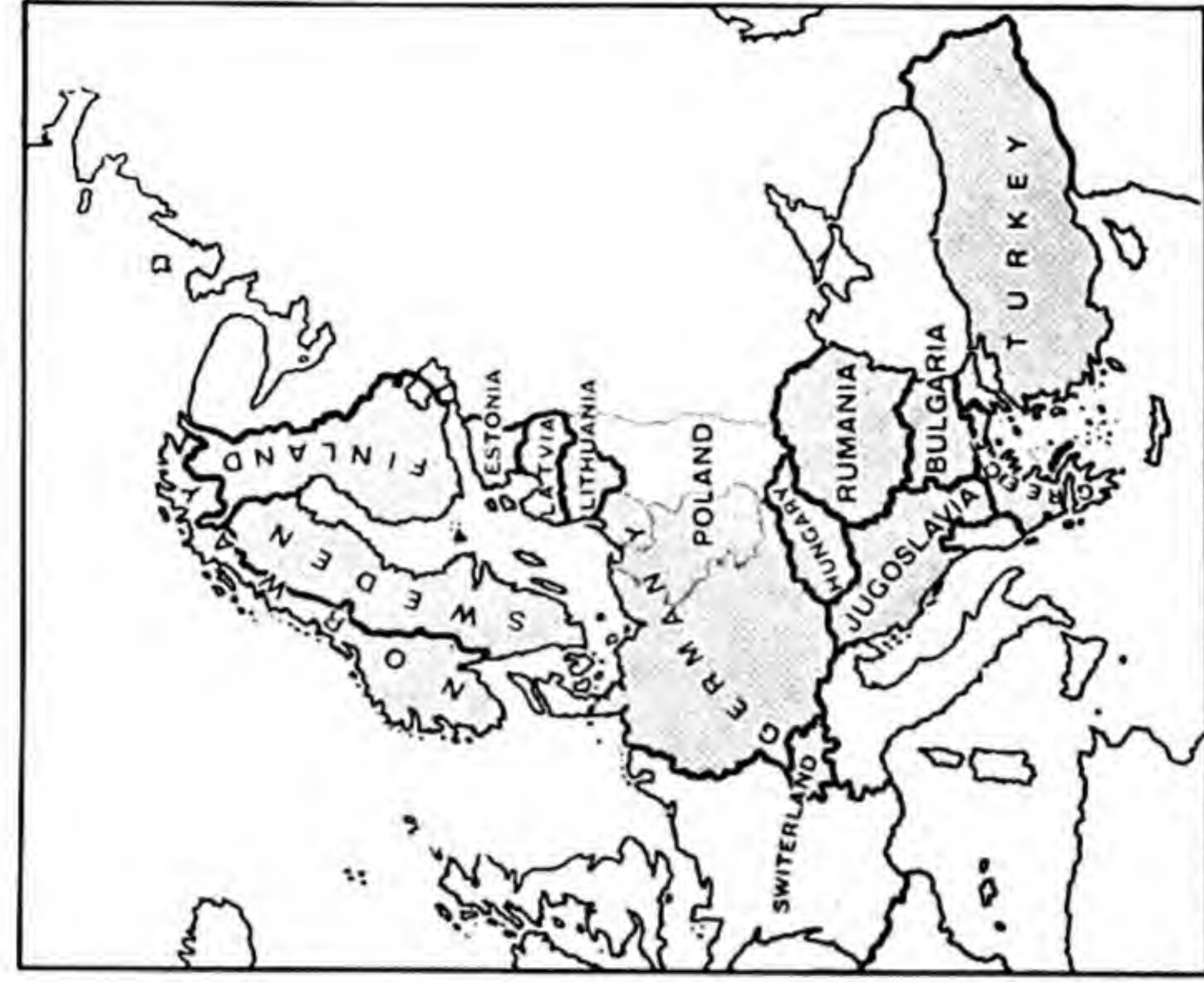
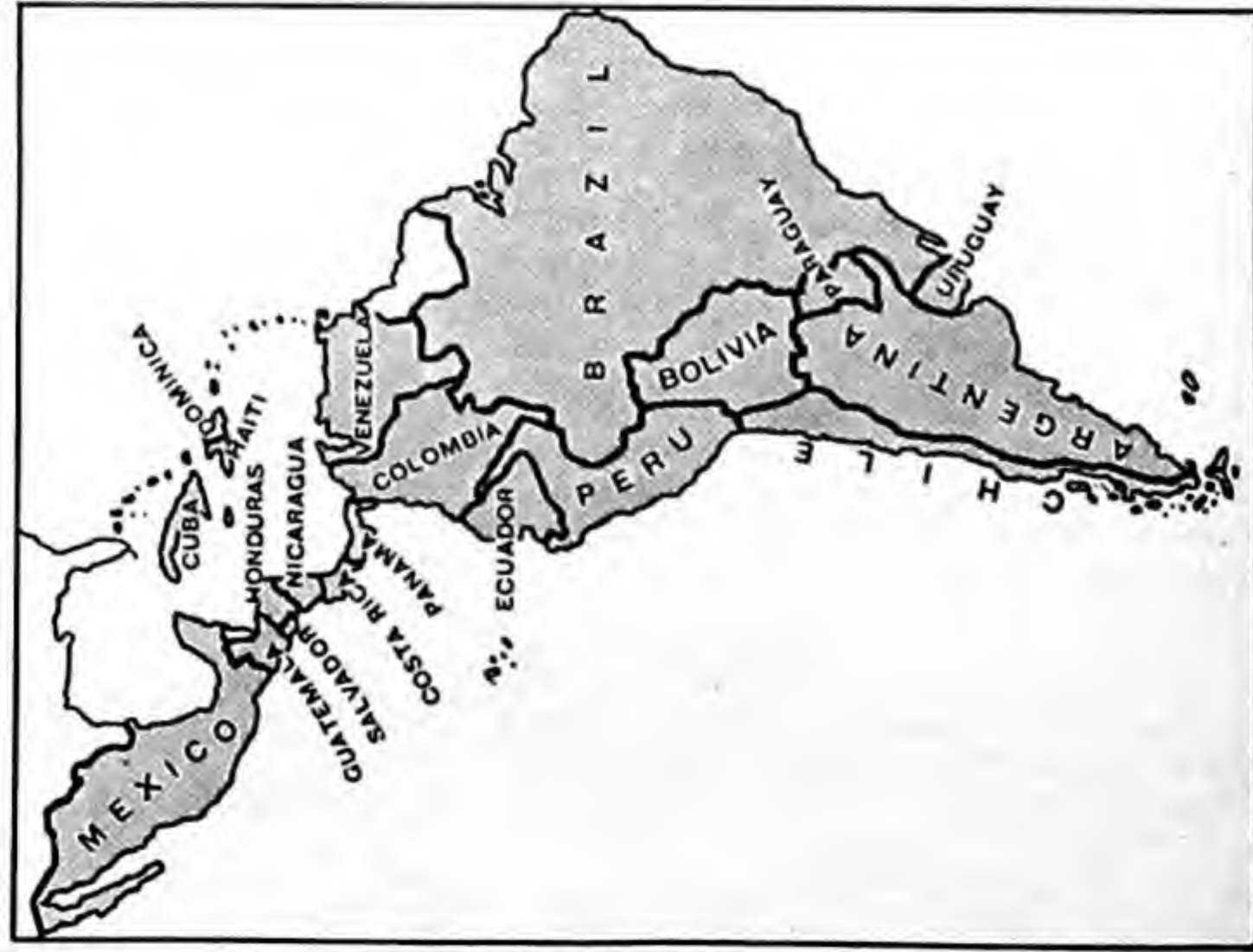
In Europe and Asia : Russian Soviet Federated Socialist Republic, Ukrainian Soviet Socialist Republic, White Russian S.S.R., Azerbaijan S.S.R., Georgian S.S.R., Armenian S.S.R., Turkmen S.S.R., Uzbek S.S.R., Tadzhek S.S.R., Kazakh S.S.R., Kirghiz S.S.R., Bashkir Autonomous Soviet Socialist Republic, Daghestan A.S.S.R., Karelian A.S.S.R., Tartar A.S.S.R., Chuvash A.S.S.R., Buriat-Mongolian A.S.S.R., Yakut A.S.S.R., A.S.S.R. of Volga Germans, Kara-Kalpak A.S.S.R.

JAPAN

In Asia and the Pacific : Japan Proper (Honshu, Shikoku, Kyushu, Hokkaido, the Kurile, Karafuto), Chosen, Manchukuo, Eastern China, Taiwan, Luchu Islands, Hainan, Pacific Islands (Bonin, Pescadores, Ladrones, Caroline, Marshall).

OTHER COUNTRIES

Thai, China, Mongolia, Sinkiang, Tibet, Afghanistan, Iran, Iraq, Saudi Arabia, Oman, Yemen, Egypt, Liberia.



REVISION AND BIBLIOGRAPHY

REVISION QUESTIONS

1. Write a brief account of the earth's place in the universe.
2. State what are the following : meteors, comets, planets, constellations, sedimentary rocks, igneous rocks, artesian wells, isobars, isotherms, isohyets, contour lines, plateaus, rift valleys, glaciers, asphalt, volcanoes, hurricanes, earthquakes.
3. Write short notes on any of the following : a light year, the Glacial Age, gravitation, a solar eclipse, the cause of day and night, erosion, young folded mountains, residual mountains, tides, groundwater, the stratosphere, the international date line, the earth's revolution round the sun, thunderstorms.
4. What are lines of latitude and longitude, and when and how are they made use of?
5. Explain why the moon shines with a different shape on different nights during the month.
6. Give a full account of the mineral fuels, stating where they are extensively produced.
7. State any facts you have learned about five of the following : the shape of the earth, soil, the world's highest plateaus, ocean currents, prairies, pampas, steppes, savannah, taiga, tundra, steel.
8. From where are the following obtained and what is their use to man : iron, tin, graphite, radium, diamonds, asbestos, lead, aluminium, pearls?
9. Give the names, positions and any interesting facts you know about : 6 great mountain ranges, 6 lofty peaks, 6 great rivers, 5 oceans, 5 seas, 4 lakes, 4 waterfalls, 3 canals.
10. Explain how man's life is affected by climate.
11. Temperature and precipitation determine the climate of a place. On what factors do they depend?

12. Write an account of the animal life in any of the following places : the equatorial forests, the tropical grasslands, the temperate lands, the coniferous forests, the polar seas.

13. State in which vegetation zone the following places are situated, and write a few lines about the climate and vegetation of each : the British Isles, southern Canada, south-east Australia, Cape Town, northern Chile, Egypt, southern United States, Ceylon.

14. Name the following and state how and from where they are obtained :

- (a) 5 materials used in making clothing.
- (b) 3 substances used in making beverages.
- (c) 3 substances used in making shoes.
- (d) 3 substances used in making confectionery.
- (e) 3 substances used in making soap.
- (f) 5 substances used in flavouring food.

15. Write a short description of the kind of life lived by a person whose home is in any of the following places :

- (a) on the Arctic shores of Canada ;
- (b) in the Congo forest ;
- (c) in southern Siberia ;
- (d) in south-western Australia ;
- (e) in South Island, New Zealand ;
- (f) in the Central Sahara ;
- (g) in London, New York, Calcutta or Johannesburg.

16. What are the following, from where are they obtained, and for what are they used ?

brazil-nuts, chicle, sal, jarrah, tonca-beans, cassava, balata, arrowroot, sponges, maté, tagua-nuts, tungsten, mother-of-pearl, pumice stone.

17. Describe a river's journey from source to mouth.

18. Give a short account of the world's chief means of transporting goods.

19. Explain all the possible ways in which a London editor may receive news and pictures from all parts of the world for his paper.

20. On blank maps of the world fill in :

- (a) the names of the continents, oceans and seas ;
- (b) the tropical temperate and polar regions ;
- (c) the chief forest, grassland and desert regions ;
- (d) the most important fishing grounds ;
- (e) the chief manufacturing areas and the main trade-routes ;
- (f) the regions noted for their cultivation of : rice, maize, wheat, barley, coffee, cocoa, tea, sugar.

21. Give your views on any of the following :

- (a) "Physical geography is in some ways the pleasantest of sciences. It is so concrete." JULIAN HUXLEY
- (b) "To those who use their eyes, a market can give a great deal of information. From the produce exposed for sale it is not difficult to form a fairly accurate estimate of the daily occupations of the people of the district, of the domestic conditions under which they live, and of their wealth or poverty as the case may be." PAUL EDMONDS
- (c) "The good traveller has the gift of surprise. He is perpetually interested by the differences he finds between what he knows at home and what he sees abroad." W. SOMERSET MAUGHAM
- (d) "Travellers are always discoverers, especially those who travel by air." ANNE MORROW LINDBERGH
- (e) "Every travel book I have read states that the author saw the eyes of wild beasts shining at night. Some are lucky or observant and only say so when a fire or a torch is nearby. Others are less fortunate ; and they lie. Think what it means! In order that eyes should gleam of their own accord in complete darkness there would have to be a light, self-generated in the brain. In a completely obscured room no cat is visible at all, but flash a light in its face, or light a fire, and the bright glossy surface of the eyes acts as a reflector." JULIAN DUGUID

SUBJECTS FOR DISCUSSION

1. Discuss the most suitable places for any of the following people to go :

- (a) a party of students with three weeks' holiday in which they wish to see lofty mountains, a glacier, a large river, olive and orange trees, the sea and a large city ;
- (b) a young man with six months to spare and a desire to do a little exploring ;
- (c) a girl who is interested in botany and can spend a year in travelling ;
- (d) a photographer who wishes to make a collection of animal photos and can be away from his office for six months ;
- (e) an elderly lady and gentleman who wish to spend 12 months seeing as many of the world's sights as possible ;
- (f) a couple of boys, who enjoy adventures, have £20 to spend and a month's holiday ;
- (g) a man with a family who wants to buy land where he can settle and cultivate crops for export ;
- (h) a scientist who collects insects ;
- (i) a writer who wishes to obtain material for a novel ;
- (j) a mining prospector who hopes to get rich quickly.

2. In which part of the world is the life of ordinary people :

- (a) most difficult? (b) easiest? (c) happiest?

3. Do you think (as many travellers assert) there is little danger in being in a country where there are wild animals?

4. The extent to which the sun, the moon and the stars influence life on the earth.

5. In what ways is a study of geography of value to people?

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